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REINFORCING EFFECTS OF DIFFERENTIAL CONTINGENCIES ON VERBAL LEARNING IN EDUCABLE MENTALLY RETARDED CHILDREN.
BY- MATTSON, ROBERT H. SAGE, DANIEL D.
OREGON UNIV., EUGENE
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THE REINFORCING EFFECTS OF DIFFERENT ENVIRONMENTAL CONTINGENCIES, IN WHICH A VERBAL LEARNING TASK WAS PRESENTED, WERE TESTED. THE LEARNING TASK INVOLVED A SIMULATION OF THE PROCESS BY WHICH THE PUPIL APPROACHES BEGINNING READING THROUGH THE ACQUISITION OF A BASIC SIGHT VOCABULARY. THE CRITERION FOR MEASURING DIFFERENTIAL EFFECT WAS ESTABLISHED AS THE NUMBER OF VISUAL SYMBOLS AND SPOKEN WORDS CORRECTLY ASSOCIATED ON A RECALL AND RECOGNITION TEST ADMINISTERED AT THE END OF EACH LEARNING SESSION. FIVE DIFFERENT CONTINGENCIES WERE ESTABLISHED AND ADMINISTERED TO APPROXIMATELY 100 SUBJECTS. THE FINDING OF GREATEST RELEVANCE TO RESEARCH ON DIFFERENTIAL REINFORCEMENT WAS THE ABSENCE OF STATISTICALLY SIGNIFICANT DIFFERENCES ACROSS THE REINFORCEMENT CONTINGENCIES. (GD)

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# Reinforcing Effects of Differential Contingencies on Verbal Learning in Educable Mentally Retarded Children

Grant No. 32-47-0230-1008

Robert H. Mattson
and
Daniel D. Sage

University of Oregon

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R. H. M.
D. D. S.

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# CHAPTER I

## INTRODUCTION TO THE PROBLEM

Public school classes for educable mentally retarded children generally have as an ultimate objective the development of social competency for independent living and self support. The attainment of such an objective includes the development of some basic academic skills, particularly a degree of literacy appropriate to the intellectual capacity of each individual. All pupils in an educable mentally retarded (EMR) program as generally defined within the legal structure of most school systems of the United States have the learning potential and the need for some skill in reading, however small. It can safely be assumed that such skills will not be gained easily, or without instruction.

Basic reading instruction, whether utilizing a phonics or a sight reading approach, involves a large amount of rote memorization of associations between spoken language or extensional reality and the visual configurations on the printed page. While more advanced reading skill may develop through the use of generalization and transfer on the basis of similar elements, the acquisition of the basic sight vocabulary is largely a rote process of making associations which are lacking in any inherent relationships. The visual configurations bear no physical similarity to the concepts they represent. Therefore, the techniques which best facilitate the formation of those associations are important topics for research with EMR children.

While the various theories of learning place different degrees of emphasis on what conditions most affect learning and the extent to which the concept of reinforcement enters in, for the purpose of this study an assumptive position consistent with reinforcement theory was taken, that learning can only be demonstrated by changes in performance, and such changes are effected by the conditions in the environment which prove to be reinforcing, i.e., cause the behavior to be more likely to occur again. On this basis an effort to identify what conditions are most reinforcing is in order.

Reinforcement of behavior may be affected by a wide range of stimulus conditions. These conditions may be related to the satisfaction of needs in the physical, emotional, or social realm. They may take a very tangible form or be entirely symbolic. While it is difficult to isolate and identify all the reinforcing elements operating in a given situation, it is probably safe to assume that within the regular scholastic world reinforcements are largely in the social realm, such as verbal praise, or tend to be of a symbolic nature, such as gold stars or "A" grades. Very seldom, for the poor student especially, is there an opportunity to experience any intrinsic satisfaction from the learning process itself. It would seem to follow, therefore, that if any particular type of reinforcing contingency can be found to be consistently more effective in promoting a change in performance, it would have practical application to classroom instruction.

## Statement of the Problem

In accordance with generally accepted definitions of mental retardation, EMR pupils[1] would be expected to have a more difficult time dealing with symbols and abstractions than would normal pupils, and would therefore show more efficient learning when the environmental contingencies contain reinforcing elements that are tangible as opposed to reinforcing elements that are largely symbolic. It might further be hypothesized that if such differential effects do exist, they would be more pronounced in pupils whose intelligence deviates most from the normal, and among those pupils who because of relatively low mental age and/or low social class status are least adequately equipped to adopt the values of the scholastic system with its orientation toward relatively symbolic and abstract reinforcements.

The purpose of the present study was to test experimentally the reinforcing effects of different environmental contingencies in which a verbal learning task was presented. The learning task involved a simulation of the process by which the pupil approaches beginning reading; the acquisition of a basic sight vocabulary. The criterion for measuring differential effects was established as the number of visual symbols and spoken words correctly associated on a recall and recognition test administered at the end of each learning session. Five different contingencies were established and administered. One type (R1) provided a tangible reward in the form of a piece of candy for each correct response in the learning task. Verbal praise (R2) served as a positive social reinforcement. A mark of "A" with a red pencil on the pupil's paper (R3) was used as an abstract symbolic reward, while verbal reproof (R4) for each error was used as a negative social contingency. One situation (R5) consisted of no reaction from the examiner to the subject's responses other than to supply the right response after the subject had attempted each item, as was done in all five situations in order to keep the "knowledge of results" factor constant.

---

[1] Samuel A. Kirk, Educating Exceptional Children (Boston: Houghton Mifflin Company, 1962), p. 105.

## Hypotheses to be Tested

In order to explore experimentally the above stated problem, a procedure was established to collect data to test the following hypotheses regarding verbal learning in EMR pupils:

1. Any contingency which emphasizes the correctness of a response has a greater reinforcing effect as evidenced by increased verbal learning than a contingency which provides no such emphasis. R1, R2, R3, R4, > R5.

2. Contingencies involving nutrient rewards have a greater reinforcing effect than those involving less tangible rewards. R1 > R2, R3, R4, R5.

3. Contingencies involving verbal praise have a greater reinforcing effect than those involving abstract symbols. R2 > R3.

4. Contingencies involving any type of reward have a greater reinforcing effect than those involving reproof. R1, R2, R3, > R4.

To whatever extent hypotheses 1 to 4 are true:

5. Pupils comprising the lower portion of the I.Q. range of the EMR population will be affected to a greater degree in their learning by differential contingencies than pupils comprising the upper portion of the range.

6. Pupils of lower mental age will be affected to a greater degree in their learning by differential contingencies than pupils of higher mental age.

7. Pupils of lower social class status will be affected to a greater degree in their learning by differential contingencies than pupils of relatively higher social class status.

These hypotheses were tested by exposing all of the experimental subjects to all five reinforcement contingencies, with five similar tasks, utilizing a three dimensional design to counterbalance effects of differential task difficulty and order.

# CHAPTER II

## REVIEW OF RELATED RESEARCH

Research relevant to the study of reinforcement and verbal learning with retarded children can be divided into three categories. First, there is research on reinforcement per se, which has focused to the greatest extent on operant conditioning in both animals and mentally retarded human subjects, and in which the emphasis is on performance of operant behavior with or without learning. Second is that body of research dealing with discrimination learning and the reinforcing effects of various types of rewards and punishments in other than mentally retarded subjects. Finally, there is the smaller volume of research concerned directly with retardate learning and those contingencies which affect it. Most of the latter has been concerned with institutionalized subjects and those at the trainable level, rather than with the public school educable retarded child who comprises the greater proportion of the retarded population and that portion most vitally affected by the quantity and quality of learning that may take place.

## Reinforcement and Operant Behavior

Although he has dealt much more with animals than human subjects, Skinner[1,2] has set the pattern for methodology in reinforcement research. Much attention has been directed toward a theory regarding relationships between primary and secondary reinforcements, but Skinner[3] in summarizing the status of reinforcement research suggested that the research was not designed to test learning theories and called for practical applications to discover who is reinforcing whom, with what, and to what effect. In answer to this question, much conflicting evidence has been reported.

It has been suggested by Staats and Staats[4] that much of the learning problems of retarded children may be involved with their weakness and slowness in the learning of secondary reinforcers.

Verbal praise, generally considered a type of secondary reinforcer, has been found to be effective in increasing performance.

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[1] B. F. Skinner, Science and Human Behavior (New York: The Macmillan Company, 1953), 461 pp.

[2] B. F. Skinner, The Behavior of Organisms: An Experimental Analysis (New York: Appleton Century Company, 1938), 457 pp.

[3] B. F. Skinner, "Reinforcement Today," American Psychologist, XIII (1958), 94-99.

[4] A. W. Staats and C. K. Staats, "A Comparison of the Development of Speech and Reading Behaviors with Implications for Research," Child Development, XXXIII (1962), 831-46.

Ellis and Distefano,[1] Stevenson and Fahel,[2] and Stevenson and Knights[3] working with mentally retarded children, suggest that the social reinforcement of the presence of the adult examiner exerts a powerful effect. The relative social deprivation of the institutionalized subject is a possible factor. However, Stevenson and Snyder[4] report that in an experiment involving verbal praise, verbal punishment, and a neutral contingency, the effect depended greatly on the order and sequence with which contingencies were applied, with higher mental age subjects being most differentially affected. The relative effectiveness of primary and secondary reinforcement has been examined, with conflicting findings. Hunt and Patterson,[5] studying the performance of mentally deficient children on drawing of a man, found that a candy reward had no effect, while verbal urging did result in improved performance. On the other hand, an attempt by Girardeau[1] to demonstrate secondary reinforcement by pairing a neutral stimulus (a buzzer) with the primary reinforcer (candy) with which the operant behavior had been trained, resulted in the conclusion that secondary reinforcement was weak and unstable.

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[1] Norman R. Ellis and M. K. Distefano, Jr., "Effects of Verbal Urging and Praise Upon Rotary Pursuit Performance in Mental Defectives," American Journal of Mental Deficiency, LXII (1959), 486-90.

[2] Harold W. Stevenson and L. L. Fahel, "The Effect of Social Reinforcement on the Performance of Institutionalized and Non-institutionalized Normal and Feeble Minded Children," Journal of Personality, XXIX (1961), 136-47.

[3] Harold W. Stevenson and Robert M. Knights, "Social Reinforcement with Normal and Retarded Children as a Function of Pretraining, Sex of Examiner and Sex of Subject," American Journal of Mental Deficiency, LXVI (1962), 866-71.

[4] Harold W. Stevenson and L. C. Snyder, "Performance as a Function of the Interaction of Incentive Conditions," Journal of Personality, XXVIII (1960), 1-11.

[5] Betty Hunt and Ruth M. Patterson, "Performance of Familial Mentally Deficient Children in Response to Motivation on the Goodenough Draw a Man Test," American Journal of Mental Deficiency, LXII (1957), 326-29.

Orlando and Bijou[2] and Barrett and Lindsley[3] have found candy to be an effective reinforcer, with a high degree of intrasubject consistency but great variability between subjects as to response patterns. This intersubject variability carries over into what constitutes a preferred reward. Lindsley[4] reports this variability in operant conditioning with schizophrenics, and Heber,[5] working with high grade mentally retarded, reports a similar range of choice differential, with food ranking very low as compared to other trinkets (toys, rings, comic books).

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[1] Frederick Girardeau, "The Effect of Secondary Reinforcement on the Operant Behavior of Mental Defectives," American Journal of Mental Deficiency, LXVII (1962), 441-49.

[2] R. Orlando and S. W. Bijou, "Single and Multiple Schedules of Reinforcement in Developmentally Retarded Children," Journal of Experimental Analysis of Behavior, III (1960), 339-48.

[3] Beatrice H. Barrett and Ogden R. Lindsley, "Deficits in Acquisition of Operant Discrimination and Differentiation Shown by Institutionalized Retarded Children," American Journal of Mental Deficiency, LXVII (1962), 424-36.

[4] Ogden R. Lindsley, "Operant Conditioning Methods Applied to Research in Chronic Schizophrenia," Psychiatric Research Reports, V (1956), 140-153.

[5] Rick Heber, "Motor Task Performance of High Grade Mentally Retarded Males as a Function of the Magnitude of Incentive," American Journal of Mental Deficiency, LXIII (1959), 667-71.

Attempts have been made to test Hull's[1] hypothesis that reaction potential is a function of reward magnitude. Heber's[2] method of approaching this question was to test the effects of working for a preferred reward versus working for a low preference reward. Significantly different results obtained in speed of performance, which suggest support of Hull's theory wherein changes in performance as a function of incentive motivation are considered as distinct from habit strength. Ellis[3] reports a study involving varying amounts of reward which was indefinite as to any relationship between reward magnitude and operant behavior.

The effect of rewards with emotionally disturbed subjects provides some comparative data. Levin and Simmonds[4] found that peanuts were not only a better reinforcer than verbal praise in effecting operant behavior in emotionally disturbed boys, but that praise actually had an inhibiting effect. Robertson[1] studied the effects of different rewards in modifying verbal behavior of disorganized schizophrenics, using much the same array of contingencies as in the present study. The most potent reward for some subjects was verbal praise, while for others a preferred tangible reward (candy, cigarettes, money) was most effective. The other three contingencies, reproof, tokens, and a neutral response were less effective. It was noted that response to praise and response to a tangible reward tended not to be found within the same individual subject.

---

[1] Clark L. Hull, Essentials of Behavior (New Haven: Yale University Press, 1951), p. 51.

[2] Heber, loc. cit.

[3] Norman R. Ellis, "Amount of Reward and Operant Behavior in Mental Defectives," American Journal of Mental Deficiency, LXVI (1962), 595-99.

[4] Gerald P. Levin and John J. Simmonds, III, "Response to Food and Praise by Emotionally Disturbed Boys," Psychological Reports, XI (1962), 539-46.

In a review of research on operant conditioning in mental deficiency, Headrick[2] points out that with the high grade or educable mentally retarded, operant conditioning may serve as a means of extending a limited repertoire of effective responses, especially by increasing the attention skills prerequisite to discrimination and more complex learning.

## Reinforcement and Discrimination Learning

Much of the research in this area has concerned other than mentally retarded subjects. However, it is felt that findings with emotionally disturbed subjects may also have some relevance to the retarded population. The relative effectiveness of reward and punishment in simple discrimination learning tasks has been explored in a number of studies, with conclusions pointing toward contingencies which involve some aspect of punishment being most effective. Penney and Lupton[1] contrasted the effectiveness of a reward only (candy) group, a reward-punishment group, and a punishment only (loud noise) group. The results indicated punishment to be most effective and the reward-punishment situation next best. Brackbill and O'Hara[2] report similar findings, as do Meyer and Offenbach[3] and Hetherington and Ross.[4] In each of these studies the punishment was quite innocuous, consisting of verbal reproof, and the results were interpreted in terms of increased drive and the possibility that punishment caused subjects to more quickly reject false cues where the discrimination task involved a multiple choice. In each of these studies, subjects were normal kindergarten and elementary school pupils. As such it is reasonable to assume that they had not been exposed to the repeated failure experiences of the retarded child.

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[1] J. P. S. Robertson, "Effects of Different Rewards in Modifying the Verbal Behavior of Disorganized Schizophrenics," Journal of Clinical Psychology, XVII (1961), 399-402.

[2] Mary W. Headrick, "Operant Conditioning in Mental Deficiency," American Journal of Mental Deficiency, LXVII (1963), 924-29.

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[1] R. K. Penney and A. A. Lupton, "Children's Discrimination Learning as a Function of Reward and Punishment," Journal of Comparative Physiological Psychology, LIV (1961), 449-51.

[2] Yvonne Brackbill and John O'Hara, "The Relative Effectiveness of Reward and Punishment for Discrimination Learning in Children," Journal of Comparative Physiological Psychology, LI (1958), 747-51.

[3] William J. Meyer and Stuart I. Offenbach, "Effectiveness of Reward and Punishment as a Function of Task Complexity," Journal of Comparative Physiological Psychology, LV (1962), 532-34.

[4] Mavis Hetherington and Leonard E. Ross, "Effect of Sex of Subject, Sex of Experimenter and Reinforcement Condition on Serial Verbal Learning," Journal of Experimental Psychology, LXV (1963), 572-75.

Stevenson, Weir and Zigler[1] report a somewhat similar finding involving tangible rewards, in that the condition most effective in producing discrimination learning was one in which a penalty, the loss of a colored sticker for each error, went along with the reward of a sticker for each correct response. Another experiment with tangible rewards by Terrell and Kennedy,[2] found candy to be most effective, with tokens to be exchanged later for candy more effective than either verbal praise, reproof, or a neutral situation. Brackbill and Jack[3] found most efficient learning in subjects working for a personally preferred tangible reward as opposed to those working for candy. Miller and Estes[4] report one contrary finding in which children given monetary reward were less efficient in discrimination learning than those given only knowledge of results. They suggest that this result was due to the subjects' preoccupation with counting and gloating over their hoard.

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[1] Harold W. Stevenson, M. W. Weir, and E. F. Zigler, "Discrimination Learning in Children as a Function of Motive-Incentive Conditions," Psychological Reports, V (1959), 95-98.

[2] G. Terrell, Jr. and W. A. Kennedy, "Discrimination Learning and Transposition in Children as a Function of the Nature of the Reward," Journal of Experimental Psychology, LIII (1957), 257-60.

[3] Yvonne Brackbill and D. Jack, "Discrimination Learning in Children as a Function of Reinforcement Value," Child Development, XXIX (1958), 185-90.

[4] L. B. Miller and B. W. Estes, "Monetary Reward and Motivation in Discrimination Learning," Journal of Experimental Psychology, LXI (1961), 501-04.

The relationship of social class to effectiveness of reward has been discussed by Terrell, Durkin, and Wiesley.[1] Dealing with normal subjects they found that lower class children learned better with a tangible reward (candy) while middle class children did better with symbolic (light flash) recognition for a correct response. Terrell[2] reports another study in which no difference in results was apparent for immediate reward with candy, tokens to be exchanged later for candy, and a symbolic light flash. A promise of candy to be delivered later did result in significantly less learning. These results were explained on the basis of these subjects being homogeneously middle class, and who expressed a willingness to work "for the fun of it" rather than for a pay-off. It would be reasonable to expect that a deprivation state for candy would have influence in such a situation. Terrell[3] has also dealt with manipulatory motivation, or the reinforcing effects of mastery of the environment. He suggested that the rewarding value of mastery may be culturally taught and that middle class children are more affected than lower class. The middle class emphasis on learning for learning's sake is an acquired behavior. As such, Staats, et al.[4]

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[1] G. Terrell, K. Durkin, and M. Wiesley, "Social Class and the Nature of the Incentive in Discrimination Learning," _Journal of Abnormal and Social Psychology_, LIX (1959), 270-72.

[2] G. Terrell, "The Role of Incentive in Discrimination Learning in Children," _Child Development_, XXIX (1958), 231-36.

[3] G. Terrell, "Manipulatory Motivation in Children," _Journal of Comparative Physiological Psychology_, LII (1959), 705-09.

[4] A. W. Staats, et al., "The Conditioning of Textual Responses Using 'Extrinsic' Reinforcers," _Journal of Experimental Analysis of Behavior_, V (1962), 33-40.

have pointed out that "being correct" would be expected to be a weak, if not absent reinforcer for many learners, especially children of low chronological age, low mental age, or low social class.

## Reinforcement and Retardate Learning

A thorough review of the literature on retardate learning by Stevenson[1] concludes that retardates are able to learn discrimination problems, that they show evidence of developing learning set, that conditions can be arranged to facilitate learning, and that while duller subjects generally have more difficulty, other factors than intelligence play a large part and that additional study of types of incentives is indicated. That intellectual level is not an adequate predictor of retardate learning has been cited by McPherson[2] and by House and Zeaman.[3] The latter report on a study in which both I.Q. and mental age were each individually correlated to learning of a visual discrimination task, but they make the point that attention rather than learning may be the key factor. Reference is made to Woodrow's[4] contention that there is a very low correlation between learning or gain and intelligence, and that there is no unitary learning ability. Woodrow had concluded that many specific abilities and perhaps some group factors were associated with the ability to learn, and that the high correlation between general intelligence and past achievement was due to the influence of many specific factors along with the general. McCulloch, Reswick, and Roy,[1] in reporting on a study of auditory recall of a series of words, suggest that grasp of the initial task and gain through repetitive learning are both independently related to mental age, and that common intelligence tests are inadequate in that they deal primarily with grasp. Gain, or repetitive learning is an important practical function in the mentally retarded.

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[1] Harold W. Stevenson, "Discrimination Learning," Handbook of Mental Deficiency, ed. Norman R. Ellis (New York: McGraw Hill Company, Inc., 1963), pp. 424-38.

[2] Marion W. McPherson, "Learning and Mental Deficiency," American Journal of Mental Deficiency, LXII (1958), 870-77.

[3] Betty J. House and David Zeaman, "Visual Discrimination Learning and Intelligence in Defectives of Low Mental Age," American Journal of Mental Deficiency, LXV (1960), 51-58.

[4] H. Woodrow, "The Ability to Learn," Psychological Review, LIII (1946), 147-58.

In explaining the learning deficits of the mentally retarded, Lipman[2] concludes that the evidence supports a "little-deficits" theory, due to the interaction of many variables, rather than a "big deficit" approach. He also cites a deficit in incidental learning, due to weaker internal sets in the mentally retarded, which require extrinsic motivation and guidance in order for learning to occur, while in normals a natural set takes care of it. House and Zeaman[3] have developed a theory that visual discrimination learning requires the acquisition of a chain of two responses: (1) attending to the relevant stimulus dimension, and (2) approaching the correct cue to that dimension. They suggest that the difficulty retardates have is related to limitations in the first phase rather than the second. It would follow that a methodology which makes learning very easy at first, and stringently avoids a failure set is most important, as are devices which attract and focus attention.

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[1] T. L. McCulloch, J. Reswick, and I. Roy, "Studies of Word Learning in Mental Defectives," American Journal of Mental Deficiency, LX (1955), 133-40.

[2] Ronald S. Lipman, "Learning: Verbal, Perceptual-Motor, and Classical Conditioning," ed. Norman R. Ellis, Handbook of Mental Deficiency (New York: McGraw Hill Company, Inc., 1963), pp. 391-423.

[3] Betty J. House and David Zeaman, "The Role of Attention in Retardate Discrimination Learning," ed. Norman R. Ellis, Handbook of Mental Deficiency (New York: McGraw Hill Company, Inc., 1963), pp. 159-223.

Studies of comparative types of incentives or reinforcers in retardate learning have been conflicting. House and Zeaman[1] report one study in which the approach tendency to novel stimuli caused the initial unreinforced trial in a discrimination learning task to be more effective than later reinforced trials. This finding has particular implications to research design and was taken into consideration in the present study. There has been some evidence, reported by Rudel[2] and by Ellis and Pryer[3] that certain tangible rewards served as distractors and therefore produced no better results in learning than social reinforcers.

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[1] Betty J. House and David Zeaman, "Reward and Non-reward in the Discrimination Learning of Imbeciles," Journal of Comparative Physiological Psychology, LI (1958), 614-18.

[2] R. G. Rudel, "The Transposition of Intermediate Size by Brain-Damaged and Mongoloid Children," Journal of Comparative Physiological Psychology, LIII (1960), 89-94.

[3] Norman R. Ellis and M. W. Pryer, "Primary Versus Secondary Reinforcement in Simple Discrimination Learning of Mental Defectives," Psychological Reports, IV (1958), 67-70.

In regard to reward magnitude, Cantor and Hottel[1] report no significant difference between the effects of a one versus four peanut reward in retardate discrimination learning. While some of the intersubject variability of most effective reinforcer that has been found in normal subjects can be expected to be present in retardates, some class groupings may exist. Zigler and deLabry[2] report a study involving three groups, mentally retarded, lower-class normal, and middle-class normal, who were matched on mental age. These subjects were given a concept switching task under conditions of tangible versus intangible reinforcement. The results confirmed the prediction that lower class and retarded children would do best with tangible rewards while the middle class function best with the intangible. It was also found that when each group was given its preferred type of reinforcement, there was no intergroup difference in learning.

To summarize the evidence presented by the research literature, as it relates to the questions proposed by this study, one must first note the great diversity of findings. Much of this may be explained by the indications of great intersubject variability in spite of intrasubject consistency. Contingencies that are effective due to attractive novelty for one subject may be detrimentally distractive for another. The relative reinforcing effectiveness of tangibles to intangibles is apparently dependent upon other unidentified variables. One man's meat is another man's poison. The one factor on which some consistency is reported is the evidence that contingency effectiveness may be a function of social class status. There is general agreement on the potent effect of aversive stimuli, particularly when in conjunction with positive reinforcement. This suggests the possibility that a part of the effectiveness of positive reinforcement may be a matter of avoidance of aversive stimuli. It is also evident that it is easier to identify the effects of reinforcement upon responses, attention, learning set, and such performances which by inference should effect learning, than to demonstrate a direct relationship between reinforcement and learning.

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[1] G. N. Cantor and J. V. Hottel, "Discrimination Learning in Mental Defectives as a Function of Magnitude of Food Reward and Intellectual Level," _American Journal of Mental Deficiency_, LX (1955), 380-84.

[2] Edward Zigler and Jacques deLabry, "Concept-Switching in Middle Class, Lower Class and Retarded Children," _Journal of Abnormal and Social Psychology_, LXV (1962), 267-73.

In view of these diverse findings, it appeared appropriate in the present study to focus upon the extent to which any effects may operate in any consistent way with any portion of the EMR population.

# CHAPTER III

# EXPERIMENTAL PROCEDURES

This chapter will review the development of the experimental design utilized to test the research hypotheses presented in Chapter I. The development, field testing and validation of the research instruments and methodology will be described, as will the selection and groupings of subjects and the methods of applying the experimental treatments for the collection of data.

## Experimental Design and Hypotheses

In order to test a series of hypotheses about the relationship between a number of different contingencies, a design was necessary which would allow for the application of the various treatments under such controls that the only independent variable would be the reinforcing character of the interaction between the teacher and the learner in a teaching-learning situation. In recognition of the difficulties encountered in ruling out inter-subject variables by either a random or matching method of selecting subjects, a design was desired which would allow for exposing all subjects to all treatments. It was also recognized that repeated use of the same task, or the difficulties in securing a number of truly equivalent tasks could also introduce a variable of unknown influence. The effects of practice in repeated trials on equivalent tasks, or the effects of pro-active inhibition in such a situation must also be considered.

In view of these concerns, a design was chosen which would be expected to counterbalance all of the major variables, leaving only the desired independent variable of reinforcement contingency to exert its influence on the verbal learning task. A modification of the Lindquist[1] Type V mixed design, involving counterbalancing on a three dimensional (5 x 5 x 5) model was developed since such a design would allow all treatments to be used with many combinations of subjects, tasks, orders and sequences. An original N of 100 subjects was chosen, to be divided into five groups, designated I to V, and further subdivided into twenty-five subgroups, designated Ia, Ib, etc., resulting in four subjects per subgroup. The basis and rationale for this grouping will be discussed later. Table I, Schedule of Administration of Tasks and Reinforcements by Trials and Subgroups, illustrates the procedure by which any subject, e.g., a member of a subgroup Ia, was assigned to Task A, on Trial 1, and reinforcement contingency R1.

With this design, it became possible not only to analyze the data for the main effects of differential reinforcement contingencies, but also to test for main effects of order of administration, differential task difficulty, and intergroup differences in subjects. While procedures were introduced to secure groups of subjects which would be

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[1] E. F. Lindquist, Design and Analysis of Experiments in Psychology and Education (Boston: Houghton Mifflin Company, 1953), pp. 288-92.

## TABLE I

## SCHEDULE OF ADMINISTRATION OF TASKS AND REINFORCEMENTS BY TRIALS AND SUBGROUPS

| | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5 |
|---|---|---|---|---|---|
| Task A | R1 Ia | R1 IIb | R1 IIIc | R1 IVd | R1 Ve |
| | R2 Ib | R2 IIa | R2 IIIe | R2 IVc | R2 Vd |
| | R3 Ic | R3 IId | R3 IIIa | R3 IVe | R3 Vb |
| | R4 Id | R4 IIe | R4 IIIb | R4 IVa | R4 Vc |
| | R5 Ie | R5 IIc | R5 IIId | R5 IVb | R5 Va |
| Task B | R1 IIa | R1 Ib | R1 Vc | R1 IIId | R1 IVe |
| | R2 IIb | R2 Ia | R2 Ve | R2 IIIc | R2 IVd |
| | R3 IIc | R3 Id | R3 Va | R3 IIIe | R3 IVb |
| | R4 IId | R4 Ie | R4 Vb | R4 IIIa | R4 IVc |
| | R5 IIe | R5 Ic | R5 Vd | R5 IIIb | R5 IVa |
| Task C | R1 IIIa | R1 IVb | R1 Ic | R1 Vd | R1 IIe |
| | R2 IIIb | R2 IVa | R2 Ie | R2 Vc | R2 IId |
| | R3 IIIc | R3 IVd | R3 Ia | R3 Ve | R3 IIb |
| | R4 IIId | R4 IVe | R4 Ib | R4 Va | R4 IIc |
| | R5 IIIe | R5 IVc | R5 Id | R5 Vb | R5 IIa |
| Task D | R1 IVa | R1 Vb | R1 IIc | R1 Id | R1 IIIe |
| | R2 IVb | R2 Va | R2 IIe | R2 Ic | R2 IIId |
| | R3 IVc | R3 Vd | R3 IIa | R3 Ie | R3 IIIb |
| | R4 IVd | R4 Ve | R4 IIb | R4 Ia | R4 IIIc |
| | R5 IVe | R5 Vc | R5 IId | R5 Ib | R5 IIIa |
| Task E | R1 Va | R1 IIIb | R1 IVc | R1 IId | R1 Ie |
| | R2 Vb | R2 IIIa | R2 IVe | R2 IIc | R2 Id |
| | R3 Vc | R3 IIId | R3 IVa | R3 IIe | R3 Ib |
| | R4 Vd | R4 IIIe | R4 IVb | R4 IIa | R4 Ic |
| | R5 Ve | R5 IIIc | R5 IVd | R5 IIb | R5 Ia |

matched, and learning tasks that would be equivalent, it was deemed desirable to have a method of checking, after the fact, the degree to which that goal was achieved.

It then became possible, regardless of any main effect differences on the aforementioned variables, to analyze the data in terms of the level of mental age, I.Q., or social class status of the subjects.

In order to apply statistical methods appropriate to this experimental design, it was necessary to restate the research hypotheses as given in Chapter I, in a single statistical null hypothesis, that there would be no difference between the five reinforcement contingencies in their effect upon learning.

In choosing a level of confidence for rejecting the null hypothesis, consideration was given to the fact that the implications of rejection would depend entirely upon whether the direction of the differences was consistent with those a priori predictions given in the statement of the research hypotheses. If such differences were found, the implications for educational practice would be largely one of providing objective evidence for what workers in the field intuitively suspect, yet rarely follow in practice. If differences should be found, but in some unexpected direction, alternate interpretations and additional research would appear to be needed before any implications for educational practice could be drawn. Consideration was also given to the implications for educational practice of accepting the null hypothesis when real differences might exist. The risk in this type of error would be to falsely give support to the continuation of practice which has been largely ineffective in terms of achievement of EMR pupils.

In view of the relatively low "costs" of implementing new and different reinforcement contingencies, and the readiness in the field for anything which may improve the meager results of instruction of EMR pupils reported by most reliable studies, it was deemed a lesser risk to commit a Type I error (rejecting a true null hypothesis) than to commit a Type II error (accepting a false null hypothesis). For these reasons, a confidence level of .05 was selected for testing the hypotheses, applying analysis of various techniques as outlined by Lindquist.[1]

## Selection and Grouping of Subjects

In order to be able to generalize the results of this study over the largest possible population of EMR pupils, it appeared most appropriate to draw the research sample from a portion of the EMR universe which would be fairly representative of all EMR populations, yet where sufficient numbers of subjects were available to allow some selectivity for the purpose of securing five matched groups, and to have the subjects sufficiently localized to permit reasonable costs of administration and data collection.

A single suburban school district in the San Francisco Bay area, operating eleven EMR classes at the elementary and junior high school levels provided about 165 subjects from which an initial sample of 100 could be drawn. This population was thought to be representative of suburban California communities. In this district the enrollment in EMR classes comprises approximately one per cent of the total school enrollment, indicating a somewhat different population from that found in more condensed metropolitan centers where cultural deprivation is more extensive and where enrollment in EMR classes ranges between two and three per cent of total school enrollment. In social class status, the population ranges from lower-lower class through lower-middle class. Specific data on the status characteristics of the experimental sample are presented later. The EMR population is also representative of the general California school population in terms of a large proportion being of Latin-American extraction, with a fair number coming from bi-lingual homes. Although precise classification on ethnic lines would be very difficult to accomplish, a survey of subjects' last names, by independent judges, resulted in from 30 to 50 per cent being considered of Latin-American extraction.

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[1] *Loc. cit.*

Under regulations of the State of California and the policies of the local school district, all children in EMR classes have been so placed only after individual examination by a state accredited psychologist and certified as mentally retarded by a committee composed of at least a school psychologist, teacher, nurse and school administrator. Most children have been examined on at least two different occasions, and all pupils from which this experimental sample was drawn had been examined within the past three years.

For selection of subjects, limits were set to secure subjects who could be assumed to have some measure of reading readiness, but who would still be concerned with basic reading instruction. An I.Q. range of from 55 to 80 and a mental age range from 6-0 (72 months) to 10-6 (126 months) was established. These measures were based on the latest examination certified to be valid by a school psychologist and were based on either the Wechsler-Intelligence Scale for Children or the 1960 Stanford-Binet Scale, Form L-M. In each case the mental age at the time of the experiment was determined by taking the designated I.Q. score and multiplying by the current chronological age. The variation in measured I.Q. which might occur from time to time, causing the computed mental age to deviate from an actual current measurement, was recognized. However, absolute precision of I.Q. and M.A. was deemed sufficiently unimportant to the purposes of this study so that this source of error, as well as that caused by the slight differences in standard deviation of the scores on the two instruments was ignored. It was sufficient to be assured that subjects were representative of the EMR population in general and could be further classified into the lower and upper quarters of the range represented. The selected sample consisted of 64 boys and 36 girls, a proportion consistent with that in the public school EMR population as a whole.[1]

In addition to the above selection criteria, all subjects had spent a minimum of one year in EMR classes in the district, and were free from gross sensory defects. The residence requirement proved to be an administrative problem, due to the high rate of turnover in this population. Between the time of selection of the initial 100 subjects and the application of the experimental treatments, 20 of the original subjects moved from the district. However, it was possible to replace these with subjects of essentially the same status from the reserve of pupils available, to maintain an N of 100 within the designated limits. Subjects who moved after the initiation of the actual experiment were lost to the study and no additional substitutions were made.

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[1] Seymour B. Sarason and Thomas Gladwin, Psychological Problems in Mental Deficiency (New York: Harper and Row Publishers, Inc., 1959), pp. 512-517.

Selected subjects were distributed between Groups I to V on the basis of mental age and I.Q., so that within each group an equivalent distribution of these measures would exist. Table II and Table III indicate the resulting distribution, and the mean and standard deviation of the I.Q. and mental age scores respectively, within each group. Inspection of these tables will illustrate the degree to which the five groups were made similar in measured intelligence and mental age.

In order to handle the additional variable of social class status, a measure on each selected subject was needed, both for the purpose of assuring a similar distribution within each group, and for later analysis of results on the basis of that variable. A questionnaire was developed, utilizing the Warner Index of Status Characteristics,[1] which affords a numerical score, derived from a weighted accumulation of factors based on source of income, occupation, dwelling area, and house type. A copy of the questionnaire and instructions as to the computation of the Index can be seen in Appendix A.

Questionnaires were sent to the classroom teachers of all selected subjects, asking them to complete the form to the best of their ability

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[1] W. Lloyd Warner, Marchia Meeker, and Kenneth Eells, Social Class in America: A Manual of Procedure for the Measurement of Social Status (New York: Harper and Row Publishers, Inc., 1960).

## TABLE II

## INTELLIGENCE QUOTIENT DISTRIBUTION BY GROUPS

| Intelligence Quotient | Group I | Group II | Group III | Group IV | Group V |
|---|---|---|---|---|---|
| 80 | - | - | - | - | - |
| 79 | 1 | - | - | - | - |
| 78 | 1 | 1 | 1 | - | 2 |
| 77 | - | 1 | 1 | - | - |
| 76 | 1 | - | 1 | 3 | 1 |
| 75 | 2 | 2 | - | 1 | - |
| 74 | 1 | 1 | - | 2 | 1 |
| 73 | 1 | - | 2 | - | - |
| 72 | 1 | 1 | 3 | 2 | 1 |
| 71 | - | - | - | 1 | 2 |
| 70 | 4 | 3 | - | - | 2 |
| 69 | - | 1 | 2 | 3 | - |
| 68 | - | 2 | 2 | 1 | 2 |
| 67 | 2 | 2 | 2 | 1 | 2 |
| 66 | - | - | - | - | 1 |
| 65 | - | 2 | - | 2 | - |
| 64 | 2 | 1 | - | 1 | 1 |
| 63 | 1 | - | - | 1 | 1 |
| 62 | 1 | 1 | 3 | - | 1 |
| 61 | - | - | 1 | - | 1 |
| 60 | - | - | 1 | 1 | - |
| 59 | - | 1 | 1 | - | 1 |
| 58 | 2 | - | - | - | 1 |
| 57 | - | - | - | 1 | - |
| 56 | - | 1 | - | - | - |
| 55 | - | - | - | - | - |
| N | 20 | 20 | 20 | 20 | 20 |
| Mean | 69.3 | 68.6 | 68.4 | 69.1 | 68.2 |
| S.D. | 6.1 | 5.7 | 5.7 | 5.5 | 5.7 |

# TABLE III

## MENTAL AGE DISTRIBUTION
## BY GROUPS

| Mental Age (months) | Group I | Group II | Group III | Group IV | Group V |
|---|---|---|---|---|---|
| 125-126 | 1 | - | - | 1 | 1 |
| 123-124 | - | - | 1 | - | - |
| 121-122 | 1 | - | - | - | - |
| 119-120 | - | 3 | 1 | - | - |
| 117-118 | 1 | - | - | 1 | 1 |
| 115-116 | 1 | - | - | 2 | 2 |
| 113-114 | - | 2 | 2 | 2 | 1 |
| 111-112 | 1 | 1 | 2 | 1 | - |
| 109-110 | - | - | 2 | - | - |
| 107-108 | 1 | 1 | - | 1 | 1 |
| 105-106 | 2 | - | 1 | 1 | 1 |
| 103-104 | 1 | 1 | 1 | - | - |
| 101-102 | - | 1 | - | - | - |
| 99-100 | 2 | - | 1 | - | 2 |
| 97- 98 | - | 1 | - | 1 | 1 |
| 95- 96 | 1 | 3 | 1 | 1 | - |
| 93- 94 | - | - | - | - | 1 |
| 91- 92 | - | - | - | 1 | 1 |
| 89- 90 | - | - | 2 | - | - |
| 87- 88 | 1 | - | 2 | 3 | 3 |
| 85- 86 | 1 | 3 | 1 | 1 | - |
| 83- 84 | - | - | - | - | 1 |
| 81- 82 | 2 | 2 | - | - | 1 |
| 79- 80 | 1 | 1 | 1 | - | 1 |
| 77- 78 | 1 | - | 1 | 1 | 1 |
| 75- 76 | 1 | 1 | - | 2 | 1 |
| 73- 74 | 1 | - | - | 1 | - |
| 71- 72 | - | - | 1 | - | - |
| N | 20 | 20 | 20 | 20 | 20 |
| Mean | 97.0 | 97.9 | 98.7 | 97.5 | 96.6 |
| S.D. | 16.0 | 14.2 | 14.6 | 16.0 | 14.6 |

and knowledge about the subjects' home and family situation. A local district policy designates special education teachers as counsellors and expects them to be well acquainted with their pupils' homes and families. It was therefore assumed that teachers would have sufficient information at hand to complete the questionnaires.

Inspection of the ISC scores resulting from the completed forms suggested the need for some adjusting of pupils from one group to another in order to secure a similar distribution of scores within each group. It was possible to make such adjustments without disrupting the balance between groups on the I.Q. and M.A. factors. The final distribution, mean, and standard deviation of ISC scores within each group is indicated in Table IV.

The interpretation of ISC ratings, in terms of social class equivalents, suggested by Warner, Meeker and Eells[1] places scores from 67 up in the "lower-lower" category, scores from 54 to 62 in the "upper-lower," and scores from 38 to 50 in the "lower-middle" class. Scores in between these ranges are given an indeterminant classification. It can be seen from Table IV that although the mean and mode ISC scores fell within the "upper-lower" class, a rather broad range was represented.

Sex differences were judged to be relatively less important, as compared to level of intelligence, mental age and social class status, in terms of matching subjects between groups. In view of the difficulties in getting the groups matched on the first three factors, no

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[1] Warner, op. cit., p. 127.

## TABLE IV

### INDEX OF STATUS CHARACTERISTICS
### DISTRIBUTION BY GROUPS

| Social Class Equivalent | Weighted Score | Group I | Group II | Group III | Group IV | Group V |
|---|---|---|---|---|---|---|
| | 36-38 | - | - | - | 1 | - |
| Lower Middle | 39-41 | 1 | - | - | 1 | 1 |
| | 42-44 | - | 1 | 2 | - | 1 |
| | 45-47 | 2 | 4 | 1 | - | - |
| | 48-50 | - | 1 | 2 | - | 2 |
| | 51-53 | 3 | 2 | 2 | 4 | 5 |
| Upper Lower | 54-56 | 3 | 4 | 2 | 3 | 2 |
| | 57-59 | 2 | 3 | 3 | 2 | 3 |
| | 60-62 | 4 | - | - | 1 | 2 |
| | 63-65 | 1 | 1 | 3 | 2 | 1 |
| Lower Lower | 66-68 | 2 | - | 3 | 3 | 1 |
| | 69-71 | - | 2 | - | 1 | - |
| | 72-74 | 1 | - | 1 | - | - |
| | 75-77 | 1 | 2 | 1 | - | 2 |
| | 78-80 | - | - | - | 2 | - |
| | 81-84 | - | - | - | - | - |
| | N | 20 | 20 | 20 | 20 | 20 |
| | Mean | 58.10 | 56.75 | 58.05 | 59.00 | 56.55 |
| | S.D. | 9.04 | 9.99 | 9.45 | 10.67 | 9.31 |

attempt was made to equate groups on the sex variable. Post hoc analysis of the data on the basis of sex was readily accomplished, however.

As Table I indicates, the assignment of subjects to Groups I to V on the basis of group matching, established the sequence for the administration of each task to each subject. In order to also counterbalance the five treatments (reinforcement contingencies) which would be applied, it was necessary to subdivide each group into five subgroups, a to e. This was accomplished on a purely random basis, utilizing a table of random numbers to assign four subjects to each subgroup. This method of assignment insured that all levels of M.A., I.Q., and ISC would be represented within each task by sequence combination, yet the major variable of reinforcement would be presented on the basis of random selection.

## Development and Testing of Instruments

Since the major concern of this study was to compare reinforcing effects, it was conceivable that any task on which an objective measure of learning could be taken would provide a satisfactory vehicle for making such comparisons. However, in order to be able to generalize with greatest validity to the teaching of reading to EMR pupils, a task was desired which simulated as much as possible the process through which the pupil moves in beginning reading, i.e., the association of a previously meaningless visual configuration with a familiar spoken word. In order to avoid the complications of trying to equate for different levels of existing proficiency with written language, it was deemed necessary to devise a completely new set of visual stimuli to be learned. The development of a set of symbols to substitute for letters of the English alphabet was considered but discarded on the basis that this might allow too much transfer and give an unknown advantage to subjects having a spelling knowledge of the basic sight words to be used. Therefore, spoken words were assigned a visual configuration as a whole with no regard for conditions of English spelling.

The selection of a vocabulary of spoken words to be learned was accomplished by turning to the Dolch[1] list of basic sight words. A group of nouns, pronouns, verbs, adverbs and adjectives were selected, so that two and three word phrases could be developed, using words that according to the research by Dolch are those most commonly occurring in basic reading textbooks. Since five different but equally difficult tasks were required, words were selected not only on the basis of difficulty level (where they fell within the rank order of most frequent usage) but also on the basis of a similar word being available for each of the five tasks. All words selected are from the list of 220 basic sight words or the list of 90 most common nouns, and 50 of the 55 words finally used are within the first 100 most frequently occurring words.

The presentation of words was arranged so that in each task the sequence of nouns, adjectives, and other parts of speech, as well as the content at each step of the task would be approximately equivalent. For example, page 10 of the booklet for Task A reads, "big black dogs." Therefore, the same page for Task B reads "funny white cat"; Task C, "little red balls," etc. The complete listing of words used and the sequence of presentation and repetition is shown on the record sheets for each task in Appendix B.

The same method of securing equivalent forms was utilized in developing a set of visual stimuli to be associated with the spoken words. The configurations presented within each task are repeated in a transposed or otherwise modified form in each other task. The configurations used, with the associated spoken word, are illustrated in Figure 1.

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[1] Edward W. Dolch, *Problems in Reading* (Champaign, Illinois: The Garrard Press, 1948), pp. 99-107.

In developing the learning tasks, the prime consideration was to secure tasks of an appropriate level of difficulty to be discriminating in the measurement of learning in the subjects with which the experiment was concerned. Gibson, et al.,[1] in a qualitative and quantitative study of the development of visual discrimination in children, had reported that by age eight, average children had little trouble in discriminating between letter-like forms presented in various transformations. Below that age discriminations on reversal and rotation transformations wer difficult but complete topological transformations were handled relatively easily.

On largely intuitive grounds, a set of configurations that would lend themselves to transformation into five different forms was developed. In the first trial task, only nine configurations and words were used. This task, including the achievement test administered after the practice period, was field tested on a group of EMR pupils in another school district from those in the experimental groups, but of the same general range of mental age and I.Q. The method of administering the learning task and achievement test in the field testing was much the same as that used in the final procedure and is thoroughly outlined

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[1] Eleanor J. Gibson, et al., "A Developmental Study of Discrimination of Letter-like Forms," Journal of Comparative Physiological Psychology, LV (1962), 897-906.

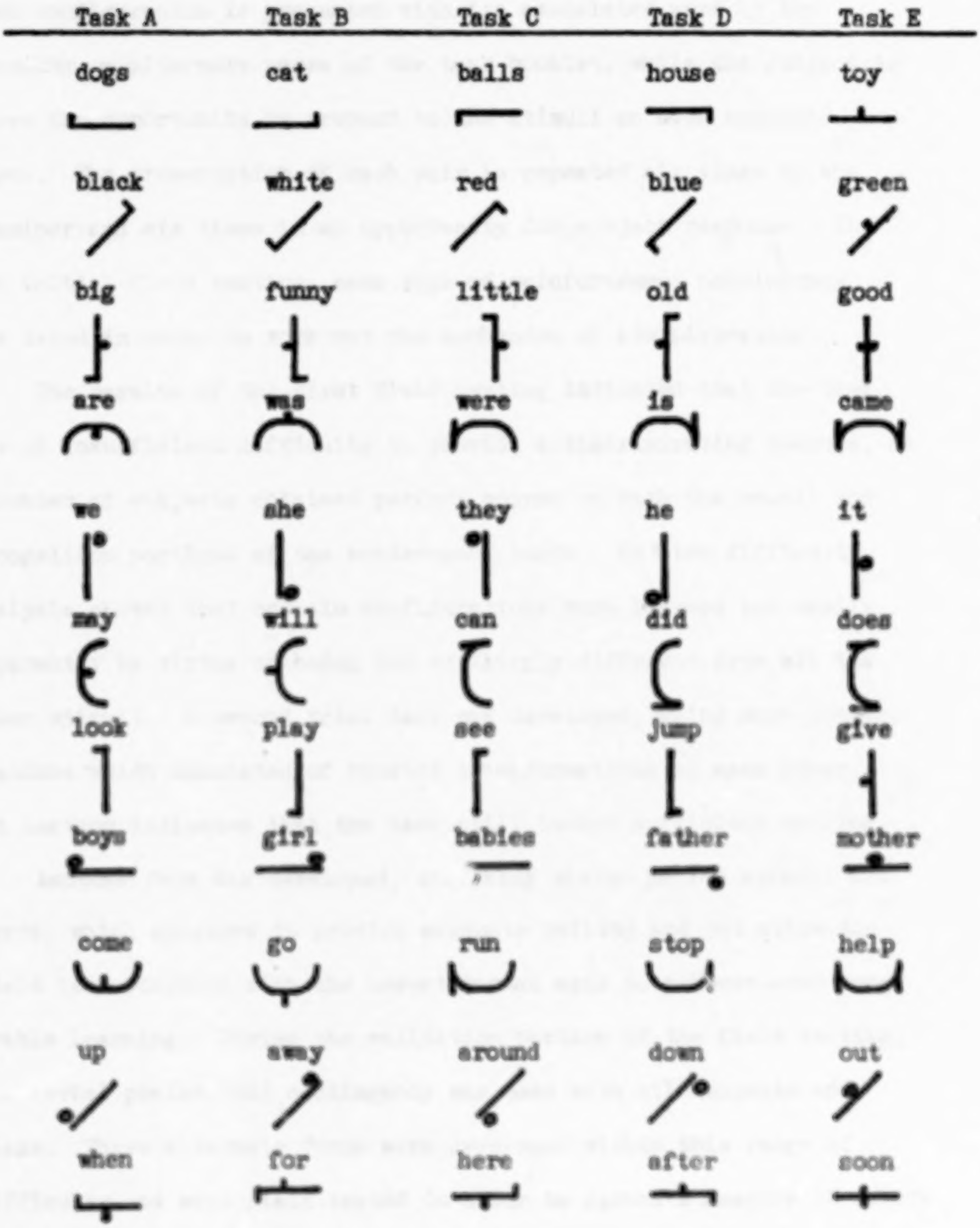
Task A
Task B
Task C
Task D
Task E
dogs
cat
balls
house
toy
black
white
red
blue
green
big
funny
little
old
good
are
was
were
is
came
we
she
they
he
it
may
will
can
did
does
look
play
see
jump
give
boys
girl
babies
father
mother
come
go
run
stop
help
up
away
around
down
out
when
for
here
after
soon

Figure 1. Visual configurations and their associated spoken words, as used in learning tasks A, B, C, D, and E.

in the Examiner's Manual (Appendix C). According to this procedure each configuration is presented with its associated word by the examiner on alternate pages of the task booklet, while the subject is given the opportunity to respond to the stimuli on even numbered pages. The presentation of each pair is repeated six times by the examiner and six times in an opportunity for subject response. In the initial field testing, each type of reinforcement contingency was tried in order to work out the mechanics of administration.

The results of the first field testing indicated that the task was of insufficient difficulty to provide a discriminating measure, as a number of subjects obtained perfect scores on both the recall and recognition portions of the achievement tests. An item difficulty analysis showed that certain configurations were learned too easily, apparently by virtue of being too strikingly different from all the other stimuli. A second trial task was developed, using more configurations which consisted of rotated transformations of each other, but testing indicated that the task still lacked sufficient ceiling.

Another form was developed, utilizing eleven paired stimuli and words, which appeared to provide adequate ceiling and yet allow the field test subjects with the lowest mental ages to achieve some measurable learning. During the validation portion of the field testing, the verbal praise (R2) contingency was used with all subjects and tasks. Three alternate forms were developed within this range of difficulty and were field tested in order to secure a measure of interform reliability. These forms became Tasks C, D, and E in the final battery, and it was assumed that the field testing results on these could be generalized to Tasks A and B, since those forms would involve only transformations along the same dimensions.

The task booklets, on which the subjects were given the training in associating the visual stimuli with the spoken words, consist of a pack of 3 x 5 inch white cards, bound together with plastic ring binding to permit ease of turning. Sixty-six pages contain the visual stimuli, with one, two, or three symbols appearing on each page. Three "warm-up" pages at the beginning were used to establish the nature of the task--to learn the meaning of some new "signs." The symbols were drawn on the cards with a black, narrow felt-tip pen, using a plastic template to insure uniformity of configuration. Sample pages of the booklet appear in Appendix D.

In the field testing, most of the pupil contact was carried out by the Co-Principal Investigator, who had personally developed the instruments and the administration procedures. Since the actual experimental treatments would be carried out by five different examiners, it was deemed advisable to determine the ease with which an examiner not involved with the development of the procedure could learn to follow it. Therefore, a brief training period in the procedure was given to two trial examiners who were experienced and trained in individual testing. Observing these examiners conducting the procedure with a number of field-test subjects made it apparent that the procedure could be readily learned by anyone having a basic background in individual testing. Some modifications in the Examiner's Manual were made at this time, bringing it to the final form which appears in Appendix C.

The criterion measure of learning was established as the number of items to which a correct response was given on the recall and recognition tests immediately following the period in which the associations were presented and practiced under the various contingencies of reinforcement. The recall test demands that the subject give the verbal associate for each visual symbol as it is pointed out on the test page. The recognition task asks the subject to pick out the correct symbol for a given verbal associate, from a multiple choice of four. Copies of the tests are in Appendix E. Criterion scores could, therefore, range from 0 to 22, with an average score of 2.75 being expected by chance alone. The scores achieved by nineteen field test pupils who were given Task D, followed by Task C one week later are shown in Table V. Scores of an additional seven pupils who had the tasks in reversed order are given in Table VI. Inspection of these scores would seem to indicate that Task C was more difficult than Task D. However, there is also an indication from Table V and from data on six subjects who had Task C followed by Task E and another group of five who had Task E followed by Task D, that scores may decline from the first administration to the second. The mean change in score of 37 subjects from their first to second trials, ignoring which specific task was involved, was a drop of 1.78, $s = 3.64$. Using a "t" test for correlated samples, this drop is significant at the .01 level. An over-all correlation between first and second trial, computed by the Pearson product moment formula, resulted in $r = .67$. This correlation, when considered with the correlations between tasks as given in Tables V and VI, seemed to indicate that the criterion measures

## TABLE V

## SCORES OF FIELD TEST SUBJECTS ON TASK D FOLLOWED BY TASK C

| Subject No. | Mental Age | Intell. Quot. | Task D | Task C |
|---|---|---|---|---|
| 1 | 120 | 72 | 15 | 12 |
| 2 | 117 | 72 | 17 | 16 |
| 3 | 117 | 77 | 15 | 13 |
| 4 | 114 | 72 | 11 | 11 |
| 5 | 113 | 75 | 21 | 16 |
| 6 | 113 | 78 | 7 | 3 |
| 7 | 112 | 76 | 13 | 8 |
| 8 | 111 | 71 | 11 | 9 |
| 9 | 102 | 69 | 22 | 14 |
| 10 | 98 | 67 | 14 | 7 |
| 11 | 96 | 76 | 15 | 11 |
| 12 | 95 | 73 | 13 | 18 |
| 13 | 93 | 65 | 13 | 10 |
| 14 | 89 | 66 | 14 | 8 |
| 15 | 87 | 62 | 11 | 7 |
| 16 | 82 | 66 | 3 | 4 |
| 17 | 80 | 66 | 9 | 3 |
| 18 | 71 | 54 | 10 | 4 |
| 19 | 71 | 52 | 7 | 7 |
| Mean | 99.0 | 68.9 | 12.42 | 9.53 |
| S.D. | 15.48 | 6.97 | 4.12 | 4.39 |

$r_{D,C} = .73$

have sufficient reliability, in view of the counterbalancing of effects of sequence and intertask differences which the particular research design provides, to permit valid conclusions to be drawn from the results on the larger sample of experimental subjects to whom the various tasks and reinforcement contingencies would be administered.

## TABLE VI

### SCORES OF FIELD TEST SUBJECTS ON TASK C FOLLOWED BY TASK D

| Subject No. | Mental Age | Intell. Quot. | Task C | Task D |
|---|---|---|---|---|
| 1 | 96 | 77 | 11 | 15 |
| 2 | 90 | 69 | 9 | 11 |
| 3 | 89 | 60 | 2 | 3 |
| 4 | 84 | 70 | 9 | 4 |
| 5 | 84 | 64 | 6 | 6 |
| 6 | 80 | 61 | 4 | 11 |
| 7 | 76 | 63 | 7 | 11 |
| Mean | 85.6 | 66.3 | 6.87 | 8.71 |
| S.D. | 5.78 | 5.43 | 2.87 | 4.11 |

$r_{C,D} = .54$

### Administration of Experimental Treatments

In order to carry out the experimental procedure with the selected EMR subjects, arrangements were made with the school district and the principals of the seven schools involved, to allow pupils to be taken, one at a time, from their classroom to a conference room in the building. Since this procedure is routinely followed in interviews with psychologists and other auxiliary personnel in the school setting, it was felt that the experience would be perceived as routine by the pupils and would arouse no special concerns.

Each session required from 20 to 30 minutes. Physical arrangements demanded a situation basically like that required for any individual testing in the school environment--a relatively private and distraction free room. An attempt was made to have a good teaching-learning environment, but one which would be fairly typical and within the normal physical possibilities of the public school. Table space sufficient for the subject and examiner to work facing each other was the only requirement other than the materials in the examiner's kit.

The examiner's kit contained the booklet of stimulus material, record sheets for recording the subject's responses during the learning period, test forms, the examiner's manual, a folding wooden screen to shield the examiner's record keeping from the subject's view, a supply of M & M candies for use in the RI contingency, and score cards and a red pencil for use in the RJ contingency.

Examiners hired to carry out the procedure were recruited from a nearby college. Six examiners were selected and trained, in order to have an alternate in case a substitute was needed for one of the five positions. All were young women, senior psychology majors, who had completed courses in experimental psychology and individual testing, as well as a practicum in individual testing with public school pupils, and were recommended by the Head of the Psychology Department.[1]

Arrangements were made for an intervening period of from one to two weeks between administrations of trials to any one subject. Examiners were supplied with lists of pupils' names and schools, by subgroup, so that by following the Schedule of Administration given in Table I, they could proceed through the entire 100 subjects, seeing approximately twenty per week.

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[1] Gratitude is expressed to Esther Lee Mirmow, Ph.D., Head, Department of Psychology, Mills College, Oakland, California, for her aid in securing personnel to serve as examiners.

Subjects were introduced to the task by the examiner explaining, "We are going to play a game with signs. Signs are things we can see, which mean something." The first two pages of the booklet, which contain a picture of a red traffic light, and the printed word, "boys" or "girls" as on a school lavatory door, were shown and discussed with the additional explanation, "I have some new signs that also mean something. You haven't seen these signs before, so I will tell you what each sign means and we will see how many of the new signs you can learn and remember."

For the R1 contingency the subject was told that for each page on which he remembered correctly, he would be given a piece of candy. The candies were kept behind the screen, near the examiner's right hand so that after each totally correct page, a piece of candy could be pushed from behind the screen onto a flat waxed paper bag in front of the subject. The bag served as a receptacle for taking the candy back to the room, in case a subject chose not to consume the candy on the spot.

For the R2 contingency the examiner responded to each totally correct page with one of an assortment of enthusiastically delivered phrases such as "Good," "Very good," "That's fine."

For the R3, the subject was told that for each correct page he would receive an "A" grade on the score-card for the game. The score-card was placed in front of the screen, near the subject's line of vision so that the examiner could easily reach out and mark the "A" with a red pencil immediately after each correct page.

For R4, the examiner reacted to each incorrect page by adding a reproof-loaded comment such as "Don't you remember?" "You forgot!" or "Try to remember!" along with supplying the correct word for each one missed. No reaction was displayed for correct responses.

For R5, the examiner remained noncommittal, displaying no reaction to correct responses, and only prompting with the correct word for each symbol on which the subject made an incorrect response, or no response within three seconds. This prompting system was utilized throughout all five contingencies in order to hold constant the "knowledge of results" factor.

In the training of the examiners, as well as in the examiner's manual (Appendix C) particular emphasis was given to the necessity of keeping each contingency "pure." It was vital to the experiment that the examiner avoid giving social reinforcement, through smiles, nods, or verbal reactions, in the case of R1, when only the candy was to be used, or in R3 when only the "A" grade was to be used. Examiners were instructed to practice maintaining a "poker face" in those situations demanding it, since the natural tendency in such a teaching-learning interaction would be a type of behavior which in this case would contaminate the effects of the different contingencies. The experience in the field testing had indicated that such separation was learned with relative ease, but did require rather constant vigilance.

Immediately at the close of the learning session with the booklet, the test form was placed before the subject with the explanation, "Let's see how many of them you can remember now." The eleven symbols were pointed out one at a time. If the subject was unable to respond within five seconds, the examiner moved on to the next symbol. The number of correct responses became the recall score, with a possible of eleven points. For the recognition portion, the subject was asked to look at the four symbols in row one, and to draw a circle around the one which means ____ (the word supplied by the examiner). The test proceeded through the eleven different words in the same manner, making a total possible of eleven additional points for the recognition test.

Scores on the recall and recognition tests, as well as a tabulation of the total number of reinforced responses during the learning session were recorded on the test form, and later transferred to a data card for each subject. The data card provided for a breakdown of data in terms of trials, tasks, and reinforcement contingencies, as well as containing information on M.A., I.Q., and ISC for each subject to allow a relatively simple means of processing and analyzing data.

# CHAPTER IV

## ANALYSIS OF RESULTS

Data collected during the administration of the experimental treatments included four numerical scores for each subject on each session as follows:

1. The number of pages on which the subject's response was correct and therefore reinforcement occurred (designated NR).
2. The number of symbols correctly recalled on the recall test at the end of each session.
3. The number of correct responses to the recognition test.
4. The sum of the latter two scores (designated TS).

The latter score (TS) was used as the major criterion for evidence of learning in the analysis of results, although performance during the reinforcement period (NR) was also scrutinized. The scores were recorded on data cards for each subject, allowing for the handling of all data in terms of the main effects of reinforcement contingencies, the main effects of differences in task difficulty, the main effects of order of administration, and the interaction of these factors. In addition, an analysis of these factors as a function of mental age, level of intelligence, and social class status was then possible.

From the 100 subjects on hand at the beginning of the administration of treatments, there was a small loss of data due to subjects moving away and invalidation by administrative error. Two subjects were lost for the entire series and an additional subject dropped out at the second, third and fourth trials. By the fifth trial a total of nine of the original 100 were lost. In order to keep the numbers constant within each cell for the analysis of variance, the missing data were "replaced" by inserting values equal to the mean of the remaining observations in the same subgroup, as suggested by Lindquist[1] and considering the appropriate reduction of degrees of freedom in applying the "F" test.

## Main Effects of Differential Reinforcement

Throughout the course of the experiment it was the subjective observation of the examiners that while a wide range of individual differences seemed to exist between subjects in the manner in which they responded to the situation, each subject appeared to be rather consistent in behavior, regardless of which reinforcement contingency was in effect. This impression was borne out in the analysis of variance of the criterion (TS) scores, which revealed a striking consistency among the five reinforcement contingencies. Table VII indicates the mean scores of the 98 subjects under each of the five contingencies, out of a possible score of twenty-two on the achievement tests. The differences are entirely non-significant, as can be seen from the summary table of the analysis of variance included in Appendix F, which gives the appropriate "F" ratios.

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[1] Lindquist, op. cit., p. 148.

### TABLE VII

### MEAN TOTAL SCORES (TS) OF 98 SUBJECTS ACROSS REINFORCEMENT CONTINGENCIES

| R1 | R2 | R3 | R4 | R5 |
|---|---|---|---|---|
| 8.35 | 8.75 | 8.60 | 8.75 | 8.78 |

While the score on the achievement test (TS) was considered to be the major criterion measure for learning, it also appeared worth while to look at performance during the reinforced practice period, as measured by the NR score. Table VIII indicates that with a possible score of thirty-three, performance was again very consistent across the five reinforcement contingencies, with no significant differences resulting. Appendix G contains the analysis of variance summary table and the appropriate "F" ratios resulting from analysis of the NR scores.

### TABLE VIII

### MEAN NUMBER OF REINFORCED RESPONSES (NR) OF 98 SUBJECTS ACROSS FIVE REINFORCEMENT CONTINGENCIES

| R1 | R2 | R3 | R4 | R5 |
|---|---|---|---|---|
| 17.89 | 18.23 | 17.77 | 17.92 | 18.12 |

The scores in Tables VII and VIII can be considered valid indicators of the effects of differential reinforcement in this experiment, since the effects of order of administration and criterion differences due to differential task difficulty were counterbalanced so as to contribute uniformly to each of the five contingencies.

### Main Effects of Order of Administration

In designing the experiment, it was anticipated that either practice or proactive inhibition might create differences purely on the basis of order of administration, and therefore the counterbalancing technique was employed. Examination of Table IX will reveal an apparent proactive inhibition effect when the criterion scores for learning (TS) are considered, as the scores on the first trial are considerably higher than on all succeeding trials. In contrast, a quite different effect is evident when considering performance during reinforced practice (NR), as the scores show an approximately linear increase across the five trials. Reference to Appendices F and G will reveal that in both cases these differences are significant.

TABLE IX

MEAN SCORES OF 98 SUBJECTS ACROSS FIVE TRIALS

| | T1 | T2 | T3 | T4 | T5 |
|---|---|---|---|---|---|
| TS | 9.83 | 7.99 | 8.29 | 8.90 | 8.22 |
| NR | 17.18 | 17.49 | 18.11 | 18.21 | 18.94 |

## Main Effects of Criterion Differences

In order to evaluate the effects of reinforcement and order of administration, an analysis of criterion differences created by a lack of equivalence in the five learning tasks was also necessary. In the initial construction of the five tasks, it had been anticipated that Task E might be somewhat more or less difficult than the other four, since the fifth transformation of the basic configuration involved a modification of a slightly different order than had the other four transformations. This or some other factor caused Task E to appear to be the most difficult, as can be seen from the scores given in Table X.

TABLE X

MEAN SCORES OF 98 SUBJECTS ACROSS FIVE TASKS

| | TA | TB | TC | TD | TE |
|---|---|---|---|---|---|
| TS | 9.48 | 8.95 | 8.19 | 8.51 | 8.10 |
| NR | 18.95 | 18.26 | 18.26 | 17.68 | 16.78 |

The relative ease of Task A, as indicated by both the TS and the NR scores was not anticipated. Although a major portion of what became the final form of Task A consisted of the first task constructed during the early experimental testing of the instruments, there had been many changes and additions which would seemingly have caused it to be of much the same difficulty as most of the other forms. Although the words selected for Task A have similar frequency ratings from the

Dolch list, it is possible that there is something "easier" about many of them that caused them to be selected when the first task was being constructed. The differences, on both the TS and the NR scores, are significant.

## Interaction Effects

In the absence of any significant main effects of differential reinforcement, the possibility of significant relationships between reinforcement and either order of administration or differences in task difficulty became of interest. It might be expected that the experience of having received one type of reinforcement would have an influence when a different type was presented. The analysis of variance of both the TS and the NR scores, as summarized in Appendices F and G respectively, reveals an absence of significant interaction between reinforcement and order of administration.

This interaction would not be expected to account for any possible effects of the sequence in which the various reinforcement contingencies were administered. While this particular design was able to utilize all possible orders of both reinforcement and tasks, it was not possible to exhaust all possible sequences with which reinforcement could be applied. As can be seen in Table I, five different sequences were utilized. The twenty subjects comprising subgroups Ia, IIa, IIIa, IVa and Va received one sequence, the (b) subgroups received another sequence, etc. The various sequences are illustrated in Table XI, with the mean criterion score on each contingency and the over-all mean score for each of the five subgroups of subjects having a common

## TABLE XI

## SEQUENCES OF ADMINISTRATION OF REINFORCEMENT CONTINGENCIES AND RESULTING MEAN TOTAL CRITERION SCORES

| Group | Sequence and Mean Scores | | | | | Over-all Mean |
|---|---|---|---|---|---|---|
| a | R1<br>9.10 | R2<br>7.55 | R3<br>7.45 | R4<br>7.95 | R5<br>8.00 | 8.01 |
| b | R2<br>9.30 | R1<br>7.45 | R4<br>7.50 | R5<br>9.15 | R3<br>7.85 | 8.25 |
| c | R3<br>9.65 | R5<br>7.85 | R1<br>8.15 | R2<br>9.25 | R4<br>9.25 | 8.83 |
| d | R4<br>10.70 | R3<br>8.75 | R5<br>8.50 | R1<br>8.85 | R2<br>7.80 | 8.92 |
| e | R5<br>10.40 | R4<br>8.35 | R2<br>9.85 | R3<br>9.30 | R1<br>8.20 | 9.22 |

sequence. It appears that the subjects who were first exposed to candy and praise had a poorer over-all performance than those who were first exposed to neutral and reproof type contingencies. Figure 2 illustrates graphically the relationships between the groups over the five trials. To test the significance of the differences between these mean scores, a critical difference figure was computed from the error variance data in Appendix F, which resulted in a "d" of .70 for significance at the .05 level.[1] It can be observed that the (a) sequence group obtained significantly poorer over-all results than (c), (d) or (e), and that

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[1] Lindquist, op. cit., p. 272.

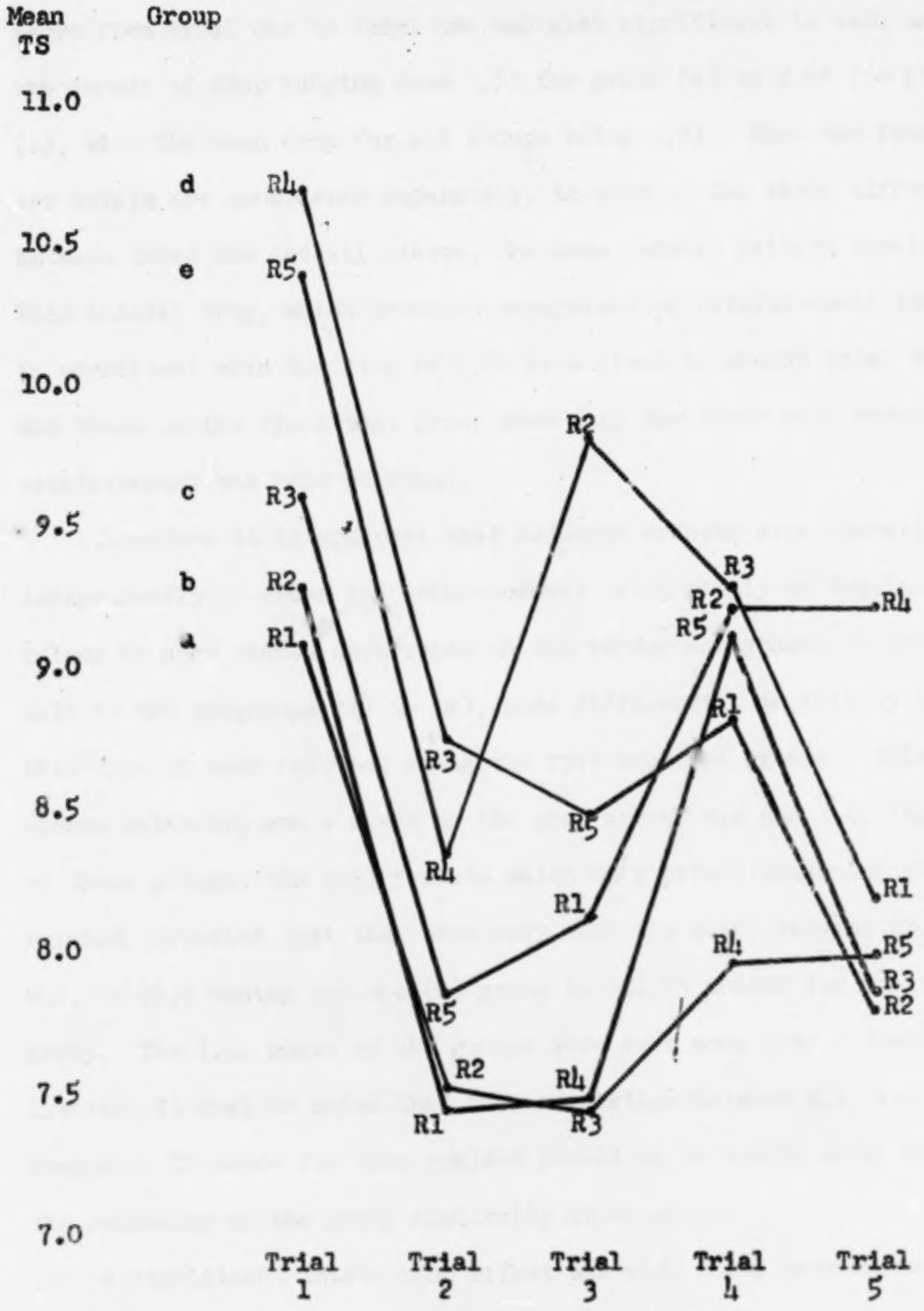

FIGURE 2

MEAN TOTAL CRITERION SCORES
OF FIVE SEQUENCE GROUPS

the (b) sequence group was significantly poorer than (e). The drop in score from trial one to trial two was also significant in each case, the amount of drop ranging from 1.55 for group (a) to 2.05 for group (c), with the mean drop for all groups being 1.84. When the four latter trials are considered separately, in view of the large differences between trial one and all others, the same general pattern remains. This initial drop, which occurred regardless of reinforcement involved, is consistent with the drop of 1.78 from first to second trial which was found in the field test group when only the tasks were changed and reinforcement was held constant.

Therefore it is apparent that sequence effects were operating, independently of order and reinforcement taken singly or together, unless by some chance occurrence in the random assignment of individuals to the subgroups (a) to (e), some differential in ability to do this type of task resulted among the five sequence groups. This is of course unlikely, and a check on the mean mental age and I.Q. figures of these groups, the only factors which on a priori reasoning might be related, revealed that they were very much the same, ranging from a M.A. of 95.5 months for the (b) group to 101.75 months for the (c) group. The I.Q. means of the groups were even more nearly identical. However, it must be noted that the correlation between M.A. and the composite TS score for each subject proved to be nearly zero, leaving the relevancy of the group similarity in doubt.

A significant interaction effect was also found between reinforcement and criterion differences, as well as between order of administration and criterion differences, which suggested a need to re-analyze the data for simple effects of each factor within each level of each of the other two factors separately. This was accomplished, using an analysis of variance for a two factor design.[1]

## Simple Effects

The analysis for simple effects revealed that much of the apparently significant differences across order of administration and criterion differences which had shown up in the main effects analysis was due to the interaction effects between those two factors. Taking each type of reinforcement separately, the analysis of variance revealed an absence of significant differences across the five tasks or the five trials. The total analysis is given in Appendix H. An "F" ratio of 2.52 would be required to attain significance at the .05 level of confidence with the appropriate degrees of freedom, and in this case the mean squares for the pertinent factors barely exceed the error variance.

A similar situation is found in analyzing for simple effects of reinforcement and order of administration on each task separately. The summary table in Appendix I indicates that in no case would a significant "F" ratio be approached.

Breaking down the order of administration factor, and analyzing for simple effects of reinforcement and criterion task differences on each trial separately, gave nearly the same results. In no case was the difference in reinforcement effects significant (Appendix J). On trial number four alone differences between tasks did reach significance, and on trial number one a significant interaction between reinforcement and tasks, suggested a further analysis of effects of reinforcement within each task on the first trial only. The summary table in Appendix K will indicate that the "F" ratio of 3.06 which would be required for significance in this case was not reached.

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[1] Lindquist, op. cit., p. 208.

## Variation in Effects as a Function of Intelligence Level

Since the total treatment population consisted of a fairly heterogeneous group ranging in intelligence from I.Q. 56 to 79, it was deemed desirable to break down the total group into a low I.Q. and a high I.Q. subpopulation, analyzing the data within each group to determine if differential effects of reinforcement existed which might have been obscured when considering the entire population as a whole.

To accomplish this the data from the twenty-five subjects having the lowest I.Q., ranging from 56 to 64, were drawn out for separate analysis. Likewise, another twenty-five with I.Q. ranging from 73 to 79 comprised a high group. The data were handled as in a treatments by subjects design, disregarding order of administration and task differences. The summary table of the analysis of variance in Appendix L indicates that the differences between reinforcement contingencies are not significant in either group. Although the mean scores for the two groups, shown in Table XII, appear to discriminate between the high and low groups, the large variance within each group, as indicated in the summary table, causes the over-all difference between the groups to miss statistical significance at the .05 level.

TABLE XII

MEAN SCORES OF HIGH AND LOW I.Q. GROUPS
ACROSS REINFORCEMENT CONTINGENCIES

| | R1 | R2 | R3 | R4 | R5 | Mean |
|---|---|---|---|---|---|---|
| High I.Q. Group | 9.80 | 9.84 | 8.56 | 10.00 | 9.44 | 9.62 |
| Low I.Q. Group | 8.44 | 8.84 | 8.68 | 7.92 | 8.80 | 8.54 |

## Variation in Effects as a Function of Mental Age

A similar method was utilized to break down the total population into two subpopulations of twenty-five each, representing the higher and lower mental age ranges. The resulting low M.A. group ranged from 72 to 85 months, while the high group ranged from 112 to 126 months. The summary table in Appendix L again indicates a high variance within each group and no significant differences across reinforcement contingencies. Table XIII gives the mean scores of the two groups. The difference between the over-all means of the high and low groups is not quite significant at the .05 level.

## Variation in Effects as a Function of Social Class

In order to look for differences in effects of reinforcement at different levels of social class status, the original treatment population was again broken down into a high and low group of twenty-five subjects each on the basis of the index of Status Characteristics.

### TABLE XIII

### MEAN SCORES OF HIGH AND LOW MENTAL AGE GROUPS ACROSS REINFORCEMENT CONTINGENCIES

| | R1 | R2 | R3 | R4 | R5 | Mean |
|---|---|---|---|---|---|---|
| High M.A. Group | 8.68 | 8.44 | 8.56 | 9.48 | 8.56 | 8.75 |
| Low M.A. Group | 6.87 | 8.00 | 7.24 | 7.37 | 8.16 | 7.55 |

The original population had ranged from 36 to 80 on the scale, with the higher scores indicating lower social class. The two resulting subpopulations ranged from 36 to 51 for the higher social class group and from 63 to 80 for the lower. The mean scores on the major criterion measure for the two groups on the various reinforcement contingencies are shown in Table XIV. Again the differences between reinforcements are nonsignificant, and there is very little discrimination between the

### TABLE XIV

### MEAN SCORES OF HIGH AND LOW SOCIAL CLASS GROUPS ACROSS REINFORCEMENT CONTINGENCIES

| | R1 | R2 | R3 | R4 | R5 | Mean |
|---|---|---|---|---|---|---|
| High Social Class | 8.40 | 9.93 | 9.28 | 9.24 | 8.96 | 9.16 |
| Low Social Class | 8.72 | 8.12 | 8.40 | 8.16 | 8.96 | 8.46 |

two groups on the basis of the criterion scores. The analysis of variance is summarized in Appendix L.

### Variation in Effects as a Function of Sex

Since the sex of subjects had been entirely disregarded in the initial grouping, there was no assurance of proportionality of sex within the various treatment groups. In light of the nonsignificant simple effects differences on any of the three factors, it appeared feasible to look at the over-all effects of reinforcement contingencies within each sex, disregarding order of administration and criterion task differences. The 36 girls and 64 boys were considered separately, as in a treatment by subjects design, the resulting mean scores across reinforcement contingencies being shown in Table XV. While the variation due to differential reinforcement appears to be much greater in the girls than in the boys, as can be seen from the summary table in Appendix M, the large error variance in each case renders the differences nonsignificant in both cases.

TABLE XV

MEAN SCORES OF BOY AND GIRL SUBJECTS
ACROSS REINFORCEMENT CONTINGENCIES

| | N | R1 | R2 | R3 | R4 | R5 | Mean |
|---|---|---|---|---|---|---|---|
| Girls | 36 | 7.25 | 8.39 | 8.22 | 8.50 | 7.58 | 7.99 |
| Boys | 64 | 8.97 | 8.95 | 8.81 | 9.05 | 9.45 | 9.05 |

## Summary of Data Analysis

The finding of greatest relevance to research on differential reinforcement in the entire analysis of data was the complete absence of statistically significant differences across the reinforcement contingencies, the interpretation of which will be discussed in the final chapter.

Also of considerable relevance was the finding of statistically significant differences on the major criterion measure, the achievement test of each task, associated with the different sequences with which the reinforcement contingencies were administered. It appeared that nutrient reward and verbal praise coming early in the sequence and followed by the other contingencies was not as effective as sequences in which the neutral and reproof contingencies came first. This will also be discussed at greater length in the final chapter.

The apparently significant differences across trials in the order of administration and across the different tasks do not remain significant when the interaction is broken down to simple effects of each factor. In any event these factors have little relevance to the major purpose of the research study, having been introduced into the design only to make possible a counterbalancing effect when exposing all subjects to all reinforcement contingencies.

# CHAPTER V

## CONCLUSIONS

The hypotheses with which this study began proposed that among the five contingencies which were to be employed, a differential in reinforcing effectiveness would be apparent, the rank order of such effectiveness being (1) nutrient reward, (2) verbal praise, (3) "A" grades, (4) verbal reproof, and (5) a neutral reaction. It was further hypothesized that these differences would be more apparent among the lower mental age, lower intelligence quotient, and lower social class portions of the total experimental population.

The major finding of the study was the complete absence of any measurable evidence of different reinforcing effects of the various contingencies employed, when each contingency was considered independently. These results, being in direct opposition to the research hypotheses, demand an exploration of their meaning to consider whether they are negative and the specific nature of the reinforcement actually makes no difference in learning, or merely inconclusive, whereby effects which may or may not have been present were only undetectable by the procedures employed.

The results in themselves do not prove that different contingencies have no differential reinforcing effect but they certainly fail to give any support to the hypotheses that performance on a verbal learning task is influenced differentially by the nature of specific reactions of the teacher to a learner's responses in such a task. It is therefore in order to consider some of the factors which might have contributed to the finding of no difference, including the possibility that no real differences exist.

## Factors Contributing to Lack of Differences

When designing the procedures for administration of the experimental treatments, care was taken to hold constant as far as possible in the five different sessions everything except the examiner's reaction, which was assumed to be the reinforcing element in the teaching-learning situation. In order to maintain such controls a number of factors not ordinarily found within a classroom environment were introduced, and these factors were constant across the five reinforcement contingencies.

Among these factors were such things as the immediate feedback of knowledge of results, which is possibly quite reinforcing in itself. In addition, although the subjects had experienced individual testing interviews a number of times before, this experimental situation must be recognized as a somewhat novel occurrence when compared to routine classroom instruction, as it involved novel stimuli, novel teachers, and perhaps most crucially, the completely individual attention of the teacher. This element is rarely experienced in ordinary classroom instruction.

It is conceivable that the social presence of the individual examiner with all these factors operating in all five contingencies had sufficient effect in itself to obscure, as in a "Hawthorne effect" any differences which might exist between the experimental treatments. The lack of difference between the "neutral" contingency and the other four would seem to indicate that some major reinforcing interaction was occurring even though the examiner was scrupulously unresponsive to the subject's efforts. It was the feeling of the examiners, confirmed by observation of their work by the Co-Principal Investigator, that they had little difficulty in maintaining "pure" contingencies. They reported that they felt uncomfortable with the reproof contingency at first, but after a short time it became fairly mechanical.

The capacity of the criterion measures to actually discriminate any differences that might have existed also must be considered in the interpretation of negative or nonconclusive findings. While the error variance within subjects on the major criterion (TS) scores is large, indicating a lot of variation in scores accountable to nothing other than chance, the analysis of the results on number of reinforcements administered during the practice period (NR scores) reveals a proportionately large variability. This would indicate that the discrimination weakness was not so much in the test of achievement as in the scope of the entire learning task. The large variance may indicate that the task may not have been of sufficient length to permit a valid sample of verbal learning behavior. The instruction period in these tasks was admittedly short, but it was highly concentrated and one might reason that whatever happened in this situation would be expected to be duplicated to a less concentrated extent in the group processes and less direct stimulation which prevails in ordinary classroom instruction.

The inter-task and inter-trial reliability, taken under uniform reinforcement conditions during the field testing had yielded only modest correlation coefficients (r = .73, .67) and since the correlation of the total scores with mental age in the experimental population was found to be essentially zero, it is suggestive that the tasks were not of sufficient scope to be highly discriminating. This lack of correlation with mental age is of interest since on a priori reasoning one would expect that children of increasing mental age would, other things being equal, be more capable of learning this particular skill. The finding is consistent, however, with the observations of McPherson[1] and House and Zeaman[2] cited earlier, regarding the very low correlation between intellectual level and learning. It is possible that under the conditions of inadvertent reinforcement which were constant across the five contingencies, an extremely discriminating criterion task would have been required to assess the differential effects looked for in this study, and in this case the sample of behavior was too limited.

## Implications for Classroom Instruction

If the findings in this study are considered only a matter of inadequate sampling or unrefined measurement, little can be said as to implications for instruction. However, it can also be stated that the differential reinforcing effects of the contingencies examined in this study must not be of great magnitude if they exist at all, or this experiment, even with its limitations, would have detected some differences.

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[1] McPherson, loc. cit.

[2] House and Zeaman, "Visual Discrimination Learning and Intelligence in Defectives of Low Mental Age," American Journal of Mental Deficiency, 65: 51-58, 1960.

Evidence of some discriminative power in the tasks is to be seen in the presence of sequence effects, which will be discussed later, as well as in the finding of differences between the first and succeeding trials when order of administration is considered alone. It could be argued that the contingencies present in this study have very minor if any differential effect on verbal learning and are therefore of relatively little importance in ordinary classroom instruction also, as compared to the factors which were constant, i.e., immediate feedback, individual attention, and a generally novel situation.

It is conceivable that when ordinary classroom conditions are in effect the differences between tangible, symbolic and social reinforcement would emerge to a measurable degree, but unfortunately those circumstances were not dealt with in this study. The lack of such differences under the conditions studied here would suggest that as long as the human presence of the teacher providing feedback is a major part of the learning process, the specific nature of the feedback is not critical. Whether this would hold true in a situation in which the social aspect and the feedback aspect were isolated, such as with a teaching machine, or in a group where immediate personalized knowledge of results is not readily available, is a question for another study.

In light of the high degree of inter-subject variability the implications for instruction would be a matter of individual study of each child, to determine and to follow the procedures which prove most reinforcing to him as an individual, with the expectation that each child will be different in this respect.

## Interpretation of Sequence Effects

It was found that the over-all performance of subgroups of subjects differed significantly, apparently as a function of the specific sequence in which reinforcement contingencies were administered. This is of interest both to the consideration of the general procedures employed in this study and to implications for classroom instruction.

It should be remembered that the subjects had unrestricted opportunity to discuss with their classmates over the nine weeks period, the various "rules" of the game each in turn was playing with the visiting examiners. It quickly became known that sometimes candy would be given, sometimes "A's" etc. In some cases the examiners reported that the subject commented, with no apparent feeling but general interest, on the particular type of reinforcement being employed at that session. In at least one classroom the examiners came to be known as the "M & M Ladies." Since all five examiners utilized all contingencies an equal number of times no one person became identified with a single type. It is possible that subjects concluded that each type would be used once. At least it is certain that those subjects who had not yet received candy were aware that the possibility was forthcoming.

The significantly higher over-all performance of the groups having the neutral and reproof contingencies early in the sequence and the tangible reward later could be interpreted as an indication that those subjects were still expectant of receiving this type of contingency and were more highly motivated as a result. The subjects who experienced the tangible rewards early in the sequence had significantly poorer over-all results, which could be interpreted as an indication that these subjects perceived the succeeding sessions as a let-down. If the apparent sequence effects are real, such a finding would be consistent with the time honored belief that teachers should be distant and demanding in early stages of a relationship and withhold more positive reactions until later.

However, it must be noted that there was no peak in performance associated with the more positive rewards in any of the sequences. All groups had their best total score on the first trial, dropped strikingly on the second session, and made varying degrees of recovery thereafter regardless of which reinforcement contingencies were in effect. This should not be interpreted as an indication that change of reinforcement from the first to second trial caused the drop, since this drop was of very much the same degree as that found in the earlier field testing of the instruments, when reinforcement contingency was held constant over the first two trials. Rather, this initial drop is more likely due to the proactive inhibition effects in the change from one form of the task to another. The fact that the low and high sequence groups were so identifiable from the very first session casts considerable suspicion that the subjects assigned by chance to these groups were of different aptitude for this type of task at the outset. Although no mental age or intelligence differences were found to account for the difference in performance of these groups, the low correlation between mental age and total score in this sample renders the equality of the groups on that factor irrelevant. The interpretation of the significant sequence findings must therefore be guarded until replicated with other subjects.

This is particularly true in light of the complete absence of differential between the various contingencies in every case where the effect of subject differences was counterbalanced out. The finding of significant differences between the sequence groups does, however, provide some additional evidence of internal consistency of the criterion measures which in turn lends support to the hypothesis that the instruments were capable of discriminating differential effects of reinforcement at any point in the administration, had such differences existed.

## Relation of Results to Previous Research

The general findings of this study were basically the same as much of that reported previously in the literature cited in Chapter II, in which the effects of various reinforcement procedures varied greatly from one study to another, and a high degree of individual differences existed as to what specific type of reinforcement was most effective. The reports of Robertson,[1] Orlando and Bijou,[2] Lindsley,[3] and Heber[4] all discuss the same type of inter-subject variability which was found in this study. The expectation that by more careful control of other variables a common pattern of most effective reinforcement would emerge simply was not realized. If a "best type" of reinforcement for retardates as a group exists, this study was no more effective in identifying that type than the many studies preceding it.

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[1] Robertson, *loc. cit.*

[2] Orlando and Bijou, *loc. cit.*

[3] Lindsley, *loc. cit.*

[4] Heber, *loc. cit.*

The observation in this study regarding the differences between the first and subsequent trials, is in general agreement with the suggestion by House and Zeaman[1] that novel stimuli in themselves have a greater effect in a discrimination learning task than any specific contingency which follows as a reinforcement. This novelty element, obviously operating when order effect is considered, may well have been the key factor operating throughout the study, relegating the designed reinforcement contingencies to an insignificant role in influencing learning.

The suggestion of sequence effects in this study is consistent with the observations reported by Stevenson and Snyder[2] in which both sequence and order had a large influence on the effect of incentives on performance. Awareness of sequence and order effects in this and other studies serves primarily to set limits on what can be concluded and applied about reinforcement effects on learning and unfortunately provides little in the way of applicable principles for instruction.

The differential in specific reward effectiveness across social class reported by Terrell, Durkin and Wiesley[3] and by Zigler and deLabry[1] was not noted in this study. While the previous studies had dealt with social classes within normal children, it was expected that some similar pattern would be detected with the EMR population. Perhaps the range of social class status in this treatment population, with a ceiling at lower middle class, was simply too narrow to allow a differential to appear when the greater factor of retardation was constant, and the discriminating instruments were somewhat crude.

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[1] House and Zeaman, _loc_. _cit_.

[2] Stevenson and Snyder, _loc_. _cit_.

[3] Terrell, Durkin and Wiesley, _loc_. _cit_.

It was noted earlier that most of the previous research had dealt with either normal subjects or institutionalized more severely retarded children, and that relatively little attention had been focused on the population under scrutiny in this study. The failure to find evidence of hypothesized differential effectiveness of tangible rewards and verbal praise, which earlier research had suggested might be found in this group, may have been partly due to the comparatively high mental status of the public school EMR population. The mental age minimum of 6-0 which was imposed in order to deal with learning of a skill like reading, could have established an experimental population even more variable in responsiveness to reinforcement than previously studied populations.

## Indications for Future Research

While the results of this and previous studies suggest that no specific class of reinforcers can be identified as "best" for EMR children as a group, and that reaction to reinforcement is a rather individual matter, the evidence cannot be considered conclusive. Some modifications to the present study, which might more adequately explore the question are apparent.

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[1] Zigler and deLabry, loc. cit.

A larger sample of learning behavior, dealing with more familiar stimuli, within the regular classroom, with the regular teacher would minimize the novel stimuli effects which may have obscured all else in this study. The recognized loss of standardized procedure and controls inherent in such an approach might be well compensated by the gain in discriminative power of a longer and more reliable criterion task, in maintaining the customary setting for instruction and in making any significant results which might be found more directly applicable to classroom instruction.

Quite different results might be expected, even utilizing the same novel situation, if subjects were exposed to a greater amount of "warm-up" on such a situation so that most of the novelty would be dissipated before the effects of differential reinforcement contingencies were evaluated. Such a procedure would also allow the equating of groups on a base line performance, rather than resorting to the apparently inadequate criteria of mental age and intelligence.

The addition of contingencies without immediate feedback and without human social element would help to isolate the effect of those factors. Also, some provision for evaluating both individual and group instruction under all reinforcement contingencies would be a crucial factor in applying any results which were found.

## Summary

This study was conducted for the purpose of testing experimentally the reinforcing effects of five different environmental contingencies in which verbal learning tasks were presented. The contingencies which were hypothesized to be differentially reinforcing were (1) a tangible reward (M & M candy), (2) verbal praise, (3) an abstract symbol ("A" grades), (4) verbal reproof, and (5) a neutral situation. The tasks consisted of five parallel forms of a paired associate learning exercise, simulating beginning reading instruction. Tasks, reinforcements and groups of subjects were scheduled so that all subjects experienced all reinforcements and all tasks in a variety of sequences so that the effects of inter-subject variability, order of administration and criterion differences were counterbalanced. Subjects consisted of 100 elementary school children enrolled in EMR classes in a representative suburban school district. The experimental treatments were administered by five examiners to individual subjects in a private interview situation near the special classrooms.

The results indicated a high degree of inter-subject variability in response to the different contingencies, with no single pattern emerging to suggest a differential effect on the learning tasks by any of the contingencies employed.

The finding that in every case the first trial yielded better performance than all succeeding trials was interpreted as evidence that novel stimuli in themselves provide a greater impetus to learning than any other reinforcing conditions which follow.

The indication of an apparent differential in learning on the basis of the sequence in which reinforcement contingencies were administered was interpreted in terms of more highly motivated performance when the early demands have been stringent and rewards are anticipated, than in situations in which positive rewards have been present at first but lacking thereafter. These interpretations were made with considerable caution, however, due to the possibility that the effect was due to chance bias in sampling.

The over-all conclusions of the study were that the differential effects of nutrient reward, verbal praise, letter grades and verbal reproof are of little if any significance in verbal learning of public school EMR children as a group, due to the high degree of variability of response in such children to such tasks.

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## APPENDIX A

## INDEX OF STATUS CHARACTERISTICS*

The following scales provide a basis for rating a pupil's family's status, by applying four characteristics: (A) source of income, (B) dwelling area, (C) occupation, and (D) house type. On each of these characteristics, the rater assigns a rating from 1 to 7 by checking the appropriate number in the left hand margin. For occupation a rather extensive table (on two pages) is provided to assist the rater in making a judgment. On the other characteristics, a more brief but adequate description is provided.

### A. SOURCE OF INCOME

1. Inherited wealth
2. Earned wealth
3. Profits and fees
4. Salary
5. Wages
6. Private relief
7. Public relief and non-respectable income

### B. DWELLING AREA

1. Very high: Gold Coast, North Shore, etc.
2. High: the better suburbs and apartment house areas, houses with spacious yards, etc.
3. Above average: areas all residential, larger than average space around houses; apartment areas in good condition, etc.
4. Average: residential neighborhoods, no deterioration in the area.
5. Below average: is not quite holding its own, beginning to deteriorate, business entering, etc.
6. Low: considerably deteriorated, rundown and semi-slum.
7. Very low: slum.

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*Warner, W. Lloyd; Marchia Meeker, and Kenneth Eells, Social Class in America: A Manual of Procedure for the Measurement of Social Status. New York: Harper and Row Publishers, Inc., 1960.

## C. OCCUPATIONS

| Rating Assigned to Occupation | Professionals | Proprietors and Managers | Business Men |
|---|---|---|---|
| 1 | Lawyers, doctors, dentists, engineers, judges, high-school superintendents, veterinarians, ministers (graduated from divinity school), chemists, etc. with post-graduate training, architects | Business valued at $75,000 and over | Regional and divisional managers of large financial and industrial enterprises |
| 2 | High-school teachers, trained nurses, chiropodists, chiropractors, undertakers, ministers (some training), newspaper editors, librarians (graduate) | Business valued at $20,000 to $75,000 | Assistant managers and office and department managers of large businesses, assistant to executives, etc. |
| 3 | Social workers, grade-school teachers, optometrists, librarians (not graduate), undertaker's assistants, ministers (no training) | Business valued at $5,000 to $20,000 | All minor officials of business |
| 4 | | Business valued at $2,000 to $5,000 | |
| 5 | | Business valued at $500 to $2,000 | |
| 6 | | Business valued at less than $500 | |
| 7 | | | |

C. OCCUPATION (Continued)

| Rating | Clerks and Kindred Workers, Etc. | Manual Workers | Protective and Service Workers | Farmers |
|---|---|---|---|---|
| 1 | Certified Public Accountants | | | Gentlemen Farmers |
| 2 | Accountants, salesmen of real estate, of insurance, postmasters | | | Large farm owners, farm owners |
| 3 | Auto salesmen, bank clerks and cashiers, postal clerks, secretaries to executives, supervisors of railroad, telephone, etc. justices of the peace | | | |
| 4 | Stenographers, bookkeepers, rural mail clerks, railroad ticket agents, sales people in dry goods store, etc. | Factory foremen, electricians plumbers carpenters watchmakers | Dry cleaners, butchers, sheriffs, railroad engineers and conductors | |
| 5 | Dime store clerks, hardware salesmen, beauty operators, telephone operators | Carpenters, plumbers, electricians (apprentice), timekeepers, linemen, telephone or telegraph, radio repairmen, medium-skill workers | Barbers, firemen, butcher's apprentices, practical nurses, policemen seamstresses, cooks in restaurant, bartenders | Tenant farmers |
| 6 | | Moulders, semi-skilled workers, assistants to carpenter, etc. | Baggage men, night policemen and watchmen, taxi and truck drivers, gas station attendants, waitresses in restaurant | Small tenant farmers |
| 7 | | Heavy labor migrant work, odd-job men, miners | Janitors, scrubwomen, newsboys | Migrant farm laborers |

## D. HOUSE TYPE

1. Excellent houses. This includes only houses which are very large single-family dwellings in good repair and surrounded by large lawns and yards which are landscaped and well cared for. These houses have an element of ostentation with respect to size, architectural style, and general condition of yards and lawns.

2. Very good houses. Roughly, this includes all houses which do not quite measure up to the first category. The primary difference is one of size. They are slightly smaller, but still larger than utility demands for the average family.

3. Good houses. In many cases they are only slightly larger than utility demands. They are more conventional and less ostentatious than the two higher categories.

4. Average houses. One-and-a-half to two-story wood-frame and brick single-family dwellings. Conventional style, with lawns well cared for but not landscaped.

5. Fair houses. In general, this includes houses whose condition is not quite as good as those houses given a 4 rating. It also includes smaller houses in excellent condition.

6. Poor houses. In this, and the category below, size is less important than condition in determining evaluation. Houses in this category are badly run-down but have not deteriorated sufficiently that they cannot be repaired. They suffer from lack of care but do not have the profusion of debris which surrounds houses in the lowest category.

7. Very poor houses. All houses which have deteriorated so far that they cannot be repaired. They are considered unhealthy and unsafe to live in. All buildings not originally intended for dwellings, shacks, and over-crowded buildings. The halls and yards are littered with junk, and many have an extremely bad odor.

## WEIGHTS FOR COMPUTATION OF ISC*

| | Wgt. | Occupation Missing | Source Missing | House Type Missing | Area Missing |
|---|---|---|---|---|---|
| Occupation | 4 | - | 5 | 5 | 5 |
| Source of Income | 3 | 5 | - | 4 | 4 |
| House Type | 3 | 4 | 4 | - | 3 |
| Dwelling Area | 2 | 3 | 3 | 3 | - |

## SOCIAL-CLASS EQUIVALENTS FOR ISC RATINGS*

| WEIGHTED TOTAL | |
|---|---|
| 12-17 | Upper Class |
| 18-22 | Upper Class probable; some possibility of Upper Middle |
| 23-24 | Indeterminant; either Upper or Upper Middle |
| 25-33 | Upper Middle |
| 34-37 | Indeterminant; Upper Middle or Lower Middle |
| 38-50 | Lower Middle |
| 51-53 | Indeterminant; Lower Middle or Upper Lower |
| 54-62 | Upper Lower |
| 63-66 | Indeterminant; Upper Lower or Lower Lower |
| 67-69 | Probably Lower Lower |
| 70-84 | Lower Lower |

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*Warner, W. Lloyd; Marchia Meeker, Kenneth Eells, Social Class in America: A Manual of Procedure for the Measurement of Social Status. New York: Harper and Row Publishers, Inc., 1960.

## APPENDIX B

## RECORD SHEET

### Task A

Name ______________
Group______________

R Type ______________
R Quantity__________

Page
1. dogs
3. black
5. dogs black
7. dogs big
9. black big
11. big are
13. are black
15. are we
17. big we
19. are we
21. we may
23. may dogs
25. may look
27. look we
29. look may
31. look boys
33. big boys
35. boys come
37. come are
39. look come
41. boys up
43. up come
45. up boys
47. up dogs
49. are when
51. when come
53. when look
55. may we
57. dogs black when
59. up when
61. boys may big
63. black when
65. up come

Page
2. dogs
4. black
6. black dogs
8. big
10. big black dogs
12. are
14. dogs are black
16. we
18. we are
20. we are big
22. may
24. we may
26. look
28. may look
30. we may look
32. boys
34. boys are big
36. come
38. come boys
40. look boys
42. up
44. look up
46. boys are up
48. big dogs up
50. when
52. come when
54. look when
56. when we may
58. black dogs
60. come up when
62. may boys come
64. big black
66. when come up

# RECORD SHEET

## Task B

Name ______________
Group______________

R Type ______________
R Quantity___________

Page
1. cat
3. white
5. cat white
7. cat funny
9. white funny
11. funny was
13. was white
15. was she
17. funny she
19. was she
21. she will
23. will cat
25. will play
27. play she
29. play will
31. play girl
33. funny girl
35. girl go
37. go was
39. play go
41. girl away
43. away go
45. away girl
47. away cat
49. was for
51. for go
53. for play
55. will she
57. cat white for
59. away for
61. girl will funny
63. white for
65. away go

Page
2. cat
4. white
6. white cat
8. funny
10. funny white cat
12. was
14. cat was white
16. she
18. she was
20. she was funny
22. will
24. she will
26. play
28. will play
30. she will play
32. girl
34. girl was funny
36. go
38. go girl
40. play girl
42. away
44. play away
46. girl was away
48. funny cat away
50. for
52. go for
54. play for
56. for she will
58. white cat
60. go away for
62. will girl go
64. funny white
66. for go away

## RECORD SHEET

### Task C

Name ______________
Group______________

R Type ____________
R Quantity__________

Page
1. balls
3. red
5. balls red
7. balls little
9. red little
11. little were
13. were red
15. were they
17. little they
19. were they
21. they can
23. can balls
25. can see
27. see they
29. see can
31. see babies
33. little babies
35. babies run
37. run were
39. see run
41. babies around
43. around run
45. around babies
47. around balls
49. were here
51. here run
53. here see
55. can they
57. balls red here
59. around here
61. babies can little
63. red here
65. around run

Page
2. balls
4. red
6. red balls
8. little
10. little red balls
12. were
14. balls were red
16. they
18. they were
20. they were little
22. can
24. they can
26. see
28. can see
30. they can see
32. babies
34. babies were little
36. run
38. run babies
40. see babies
42. around
44. see around
46. babies were around
48. little balls around
50. here
52. run here
54. see here
56. here they can
58. red balls
60. run around here
62. can babies run
64. little red
66. here run around

## RECORD SHEET

### Task D

Name ______________
Group______________

R Type ______________
R Quantity___________

Page
1. house
3. blue
5. house blue
7. house old
9. blue old
11. old is
13. is blue
15. is he
17. old he
19. is he
21. he did
23. did house
25. did jump
27. jump he
29. jump did
31. jump father
33. old father
35. father stop
37. stop is
39. jump stop
41. father down
43. down stop
45. down father
47. down house
49. is after
51. after stop
53. after jump
55. did he
57. house blue after
59. down after
61. father did old
63. blue after
65. down stop

Page
2. house
4. blue
6. blue house
8. old
10. old blue house
12. is
14. house is blue
16. he
18. he is
20. he is old
22. did
24. he did
26. jump
28. did jump
30. he did jump
32. father
34. father is old
36. stop
38. stop father
40. jump father
42. down
44. jump down
46. father is down
48. old house down
50. after
52. stop after
54. jump after
56. after he did
58. blue house
60. stop down after
62. did father stop
64. old blue
66. after stop down

## RECORD SHEET

## Task E

Name ______________ R Type ______________
Group______________ R Quantity______________

| Page | Page |
|---|---|
| 1. toy | 2. toy |
| 3. green | 4. green |
| 5. toy green | 6. green toy |
| 7. toy good | 8. good |
| 9. green good | 10. good green toy |
| 11. good came | 12. came |
| 13. came green | 14. toy came green |
| 15. came it | 16. it |
| 17. good it | 18. it came |
| 19. came it | 20. it came good |
| 21. it does | 22. does |
| 23. does toy | 24. it does |
| 25. does give | 26. give |
| 27. give it | 28. does give |
| 29. give does | 30. it does give |
| 31. give mother | 32. mother |
| 33. good mother | 34. mother came good |
| 35. mother help | 36. help |
| 37. help came | 38. help mother |
| 39. give help | 40. give mother |
| 41. mother out | 42. out |
| 43. out help | 44. give out |
| 45. out mother | 46. mother came out |
| 47. out toy | 48. good toy out |
| 49. came soon | 50. soon |
| 51. soon help | 52. help soon |
| 53. soon give | 54. give soon |
| 55. does it | 56. soon it does |
| 57. toy green soon | 58. green toy |
| 59. out soon | 60. help out soon |
| 61. mother does good | 62. does mother help |
| 63. green soon | 64. good green |
| 65. out help | 66. soon help out |

# APPENDIX C

## EXAMINER'S MANUAL

### GENERAL INSTRUCTIONS

Examiner calls for subject at school office and meet S at pre-arranged examination room, take seats facing each other, across a small table. E places set of cards in front of S, with cover closed, spiral binding toward E. E places record sheet so that preferred hand can be used to record S's responses by circling each correct word, and so E can see the list of words to be provided (left hand column) and the response key (right hand column). A folding screen should be used to screen record sheet from S's view. Card numbers are in the upper right hand corner of the cards (as viewed by E). On odd numbered pages, E provides the word while pointing (with non preferred hand) to the symbol on the card. The symbols are pointed out, one at a time, pacing two seconds between symbols. On even numbered pages, E points to symbol and asks, "What is this?" If S fails to respond in 3 seconds or responds incorrectly, E points to symbol and provides correct response with no other comment (except for R4--see special instructions) and moves on to next card. If S responds correctly, E reacts according to which special instructions (R1, R2, R3) apply or makes no comment (R4, R5), maintaining a "poker face," and moves on to next card. E should pace S's responses by finger pointing and prompting when S gives no response after three seconds. E must be careful to record the results of each trial (even numbered cards) by circling each correct response on the record sheet after making the appropriate reaction to

S's response and _before_ moving on to the next card. The record sheet will provide a record of the number of reinforced responses. The most difficult task, for the average examiner, will be to maintain a neutral facial and verbal reaction in the situations calling for such. The natural reaction of the examiner in most individual testing interviews is to be pleasantly positive, to smile, nod and be verbally encouraging.

_Special instructions for R1_.

E keeps box of candies behind screen near preferred hand so that immediately after S completes correctly all the responses to that page a candy can be pushed toward S from around the screen. E makes no verbal comment and maintains a neutral facial expression. On cards with multiple symbols on which S gets some correct, E must prompt S on incorrect responses by pointing to the symbol and providing correct response.

_Special instructions for R2_.

E reacts to each totally correct page with an enthusiastic

> "Good!" "Fine!" "You're doing very well!" "Very good!"
> "That's it!"

varied sufficiently to avoid stereotypy. If S repeats correct word after E has prompted, E makes no comment.

_Special instructions for R3_.

E places a score card with S's name on it beside the card book near E's preferred hand so that he can reach around the screen and mark an A on the card with a red pencil (right side up for S) for each correct page of responses. E makes no verbal comment and maintains a neutral expression while doing this. E prompts S on incorrect responses with no other comment or reaction.

### Special instructions for R4.

E makes no comment or reaction to correct responses by S, but responds to each page on which an error is made with a frown or displeased facial expression, providing the correct response as follows:

| | |
|---|---|
| No response - (after 3 seconds) | "Don't you remember, this is ------." |
| | "You forgot, this is ------." |
| | "Try to remember, ------." |
| Incorrect response - | "No, this is ------." |
| | "That's not right, it is ------." |
| | "Try to remember, ------." |

### Special instructions to R5.

E makes no comment except to prompt incorrect responses or failure to respond, by giving the correct responses in the same manner as on odd numbered pages, after S has attempted the items on the page. E must be careful to avoid nodding, smiling, or other non-verbal communication as well as refraining from verbal responses. When beginning a session that does not involve rewards, with a S who has previously been exposed to one of the reward situations, S may inquire about rewards. E should state,

"This game is a little different from the other one."

## ADMINISTRATION

### The Learning Task

E explains:

"We are going to play a game today with signs. Signs are things we can see which mean things. This sign (show picture of red traffic light) means ------- (If S does not volunteer 'stop,' E provides answer). Here is a sign (show 'boys' or 'girls' sign) that means ------- (accept the word, if offered, or provide answer, "Boys (girls) like we see on the doors of the lavatories at school." Skip card that does not apply to sex of S.)

"I want to show you some new signs today that also mean things. You haven't seen these signs before so I will tell you what each sign means and we will see how many of the new signs you can learn and remember. If you don't remember, I will tell you again. As we go along through this book, I will tell you what the signs mean on one page, you look at the sign carefully, then you can try to tell me what the sign means on the next page. We want to try to get all the signs correct on each page."

(For R1 add)

"Each time you remember all the signs on a page correctly I will give you a piece of candy. We will see how many pieces of candy you can earn."

(For R3 add)

"Each time you remember all the signs on a page correctly I will put an "A" grade on your score card for this game. We will see how many A's you can earn." Have S write his name on the score card before starting.

E turns to card #1 and says,

"Look at this sign carefully. This sign means ------- (providing proper word from record sheet). See if you can remember it when you see it again."

E flips to card #2 and says,

"What does this mean?"

After handling S's response to card #2, according to appropriate R conditions, E flips to card #3 and says,

"I'll do this page. Look at this one. This sign means -------."

E flips to card #4, says, "*You* do this page," waits for S to respond, and handles response. On card #5 and odd numbered cards thereafter E says, "my turn," if S attempts to answer odd numbered pages, otherwise E merely points to symbols and provides the words, with no other comments. If S fails to focus on card while being shown, E should remind, "Look at this." On even numbered cards thereafter, E points to symbol and waits for S to respond. If S seems unsure as to what is expected it is permissible for E to ask,

"What's this?"

## The Achievement Test

Immediately after the last card of the learning task is completed, E removes the card book and places a copy of the achievement test before S. E keeps a duplicate copy of the test form behind the screen and records S's responses on it. The test has two parts.

### Recall

E points to the row of symbols and says,

"See how many of these you can tell me now."

E records results by writing in above the symbol any incorrect responses, circling correct responses, and leaving blank those not attempted. E makes no comment about responses and does no prompting, but says,

"That's good."

after all the recall has been attempted, regardless of results. E folds over the top part of the page on which performance on the recall test has been recorded, and places that sheet in front of S.

## Recognition

E points to first row of four symbols and says (referring to key),

"Look in Row 1. Which one is (dogs); Draw a circle around it."

E proceeds through remaining rows of symbols in the same manner. After last item E says,

"That's good."

regardless of results, acknowledges S's hard work and dismisses S suggesting,

"Maybe you can play this game again sometime."

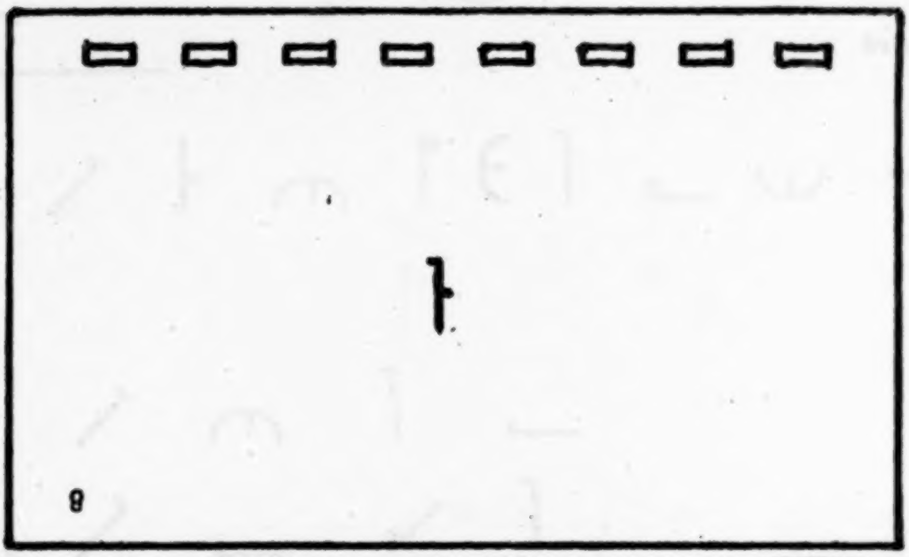
## Scoring

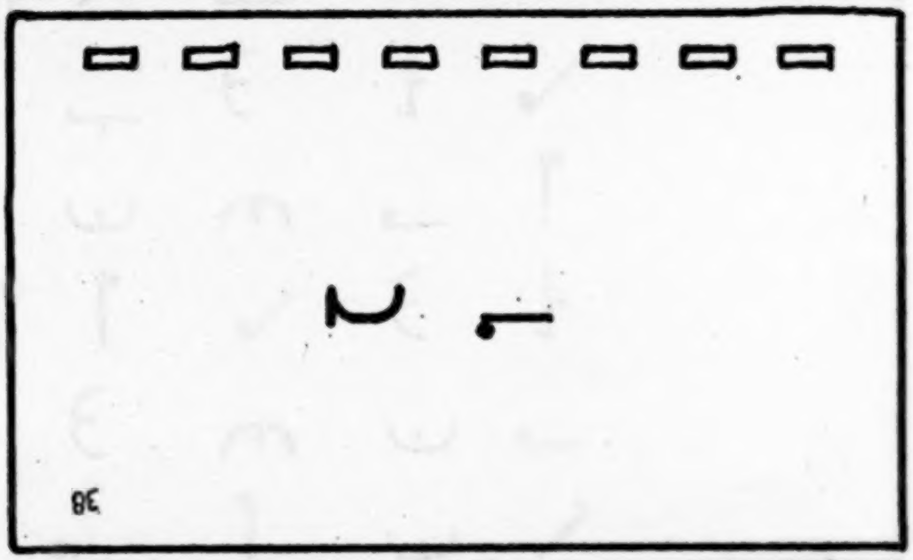
The number of correct responses on both the recall and recognition tests should be recorded in the blanks at the top of E's copy of each test form. The S's name, group number (I-V), the type of reinforcement utilized (R1-R5) and the number of reinforcers used (R Quantity) should be recorded on the test sheet.

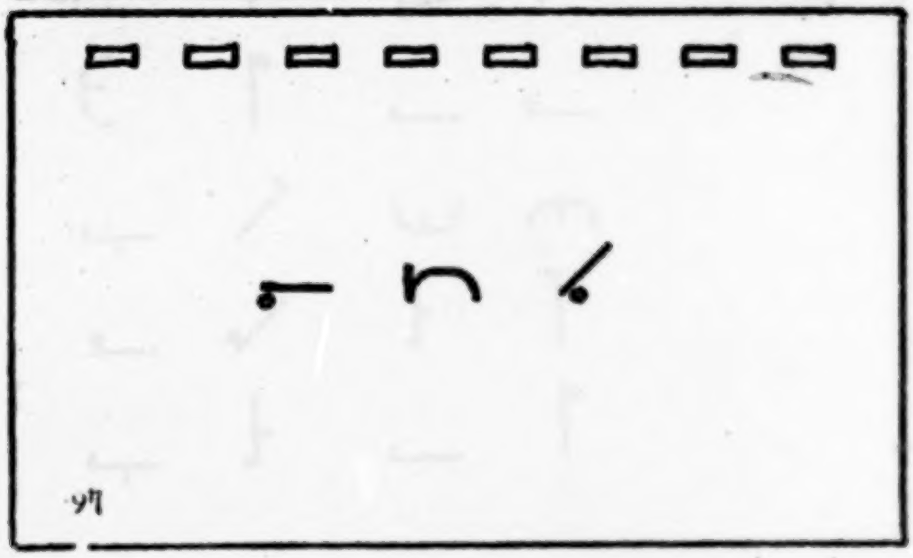
| Test A | Test B | Test C | Test D | Test E |
|---|---|---|---|---|
| 1. dogs | 1. cat | 1. balls | 1. house | 1. toy |
| 2. black | 2. white | 2. red | 2. blue | 2. green |
| 3. big | 3. funny | 3. little | 3. old | 3. good |
| 4. are | 4. was | 4. were | 4. is | 4. came |
| 5. we | 5. she | 5. they | 5. he | 5. it |
| 6. may | 6. will | 6. can | 6. did | 6. does |
| 7. look | 7. play | 7. see | 7. jump | 7. give |
| 8. boys | 8. girl | 8. babies | 8. father | 8. mother |
| 9. come | 9. go | 9. run | 9. stop | 9. help |
| 10. up | 10. away | 10. around | 10. down | 10. out |
| 11. when | 11. for | 11. here | 11. after | 11. soon |

## APPENDIX D

## SAMPLE PAGES OF TASK BOOKLETS







# APPENDIX E

## TEST SHEET FORMS

## TEST A

**Name** ______________

**Group** ______________

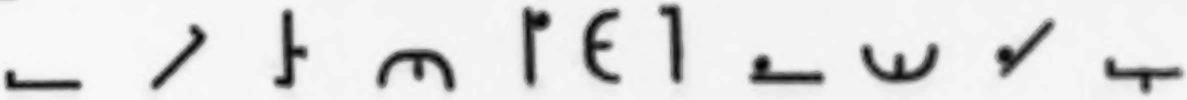
**R Type** ______________

**R Quantity** ______

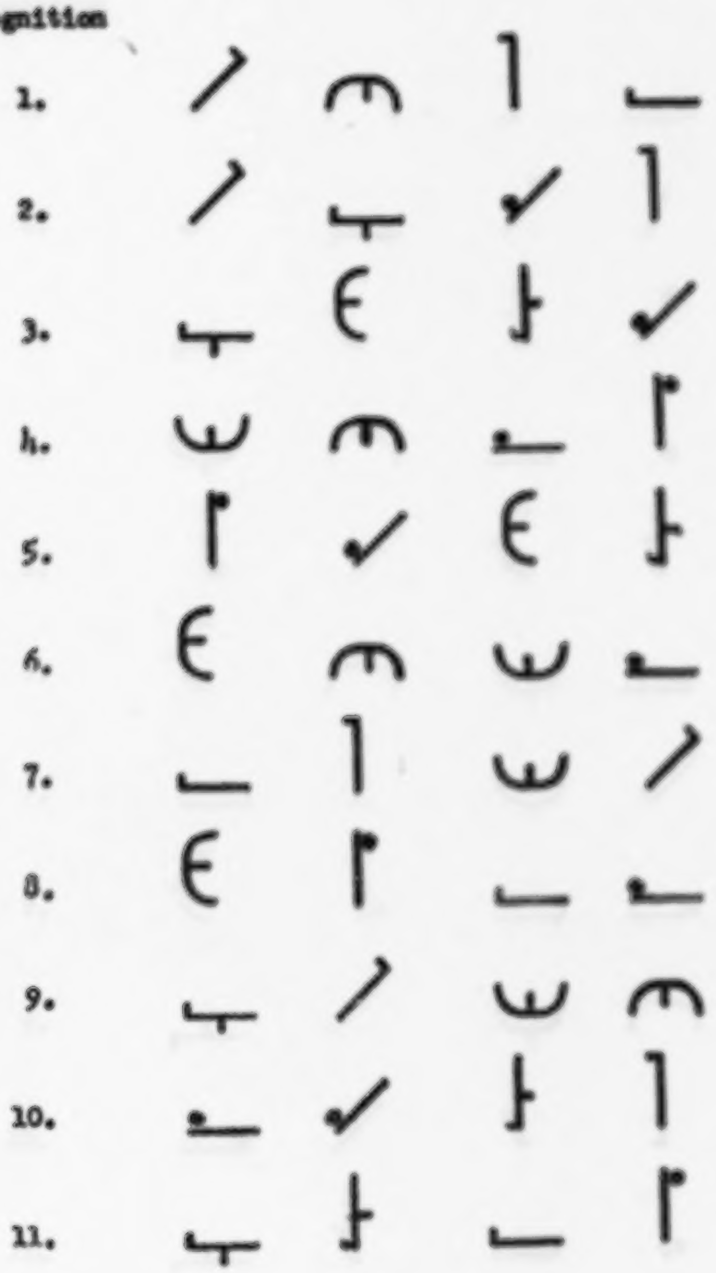
**Recall Score** ____

**Recog. Score** ____

**Recall**



**Recognition**


1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.

Name ______________

Group ______________

R Type ______________

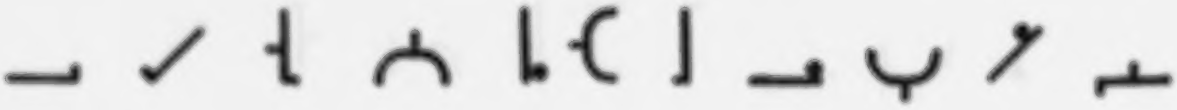
TEST B

R Quantity ______

Recall Score ____

Recog. Score ____

Recall



Recognition

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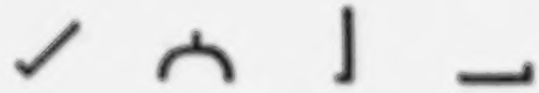

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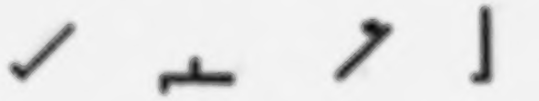

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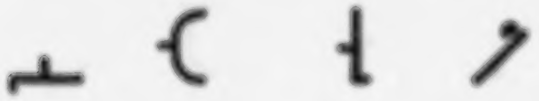

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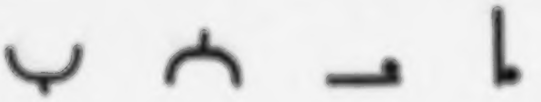

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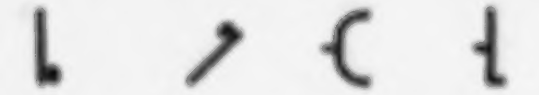

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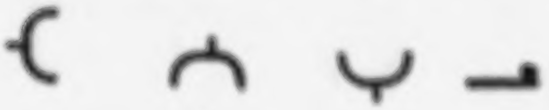

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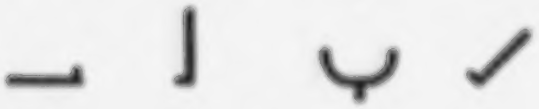

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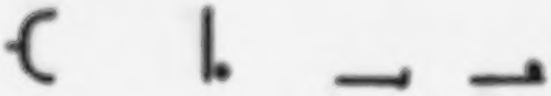

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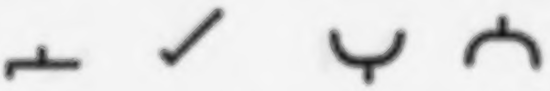

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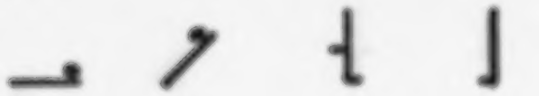

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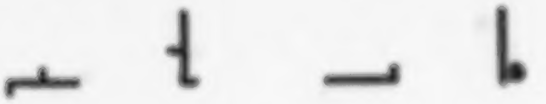


Name ____________

Group ____________

R Type ____________

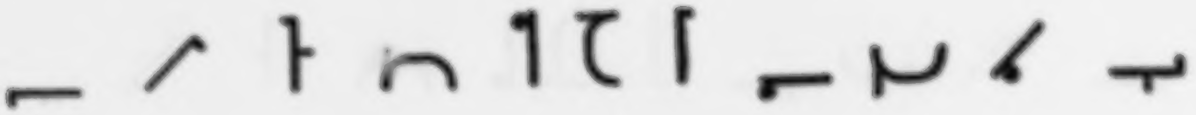
TEST C

R Quantity ______

Recall Score ____

Recog. Score ____

Recall



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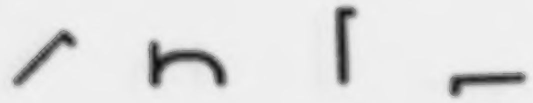

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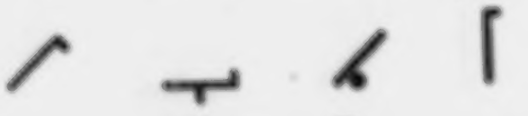

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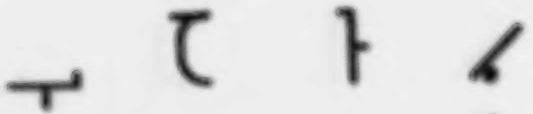

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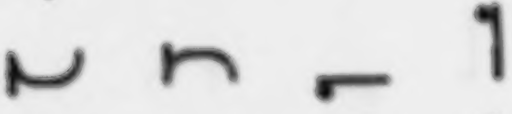

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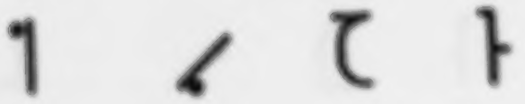

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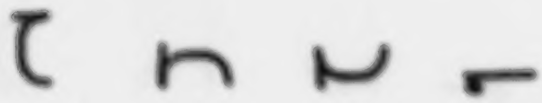

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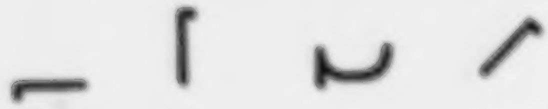

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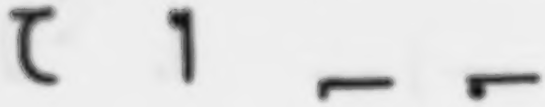

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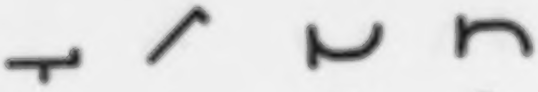

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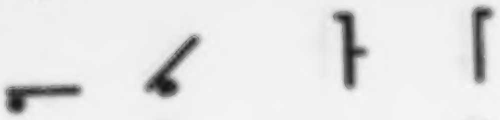

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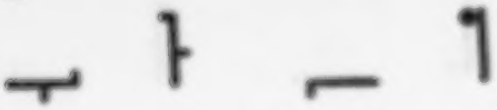


Name ____________________

Group ____________________

R Type ____________________

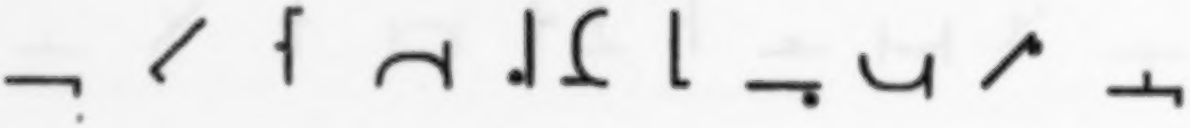
TEST D

R Quantity ________

Recall Score ______

Recog. Score ______

Recall



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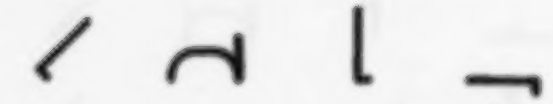

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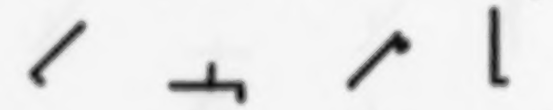

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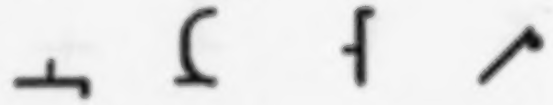

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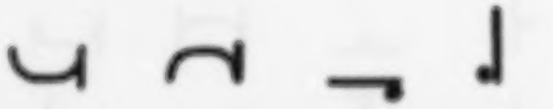

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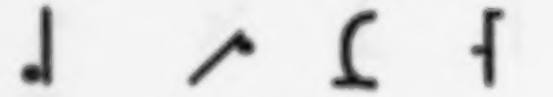

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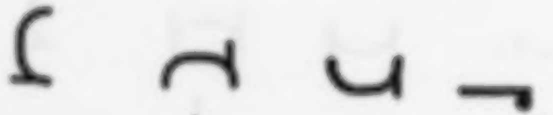

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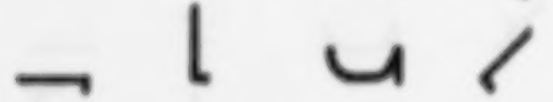

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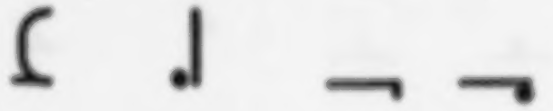
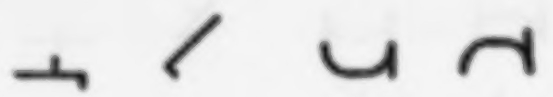


9.


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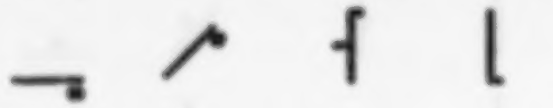
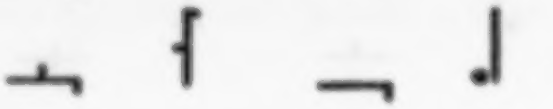


11.


Name ______________

Group ______________

R Type ______________

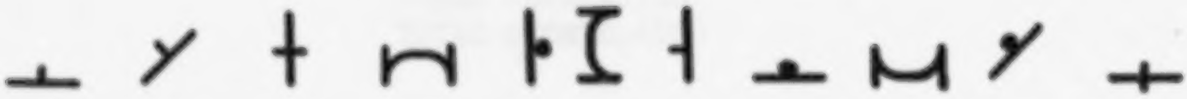
**TEST E**

R Quantity ______

Recall Score ____

Recog. Score ____

**Recall**



**Recognition**

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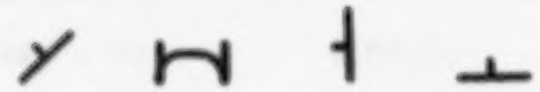

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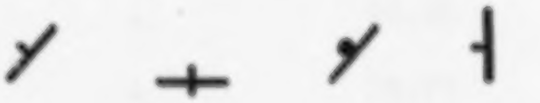

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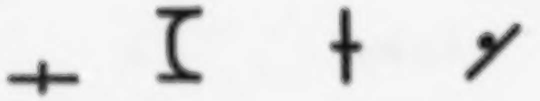

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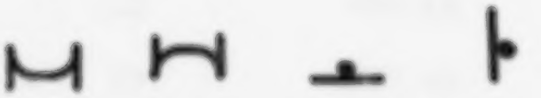

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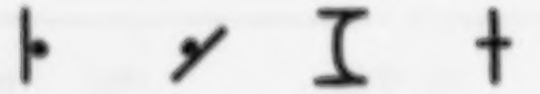

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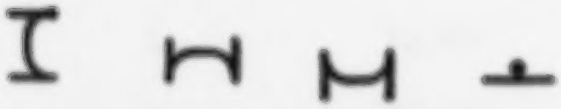

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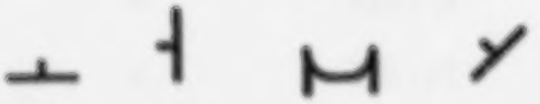

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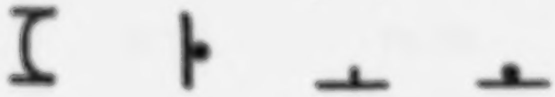

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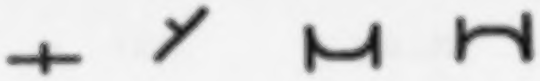

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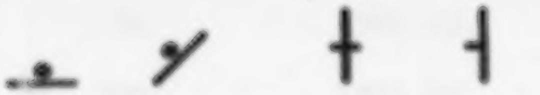

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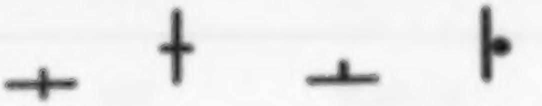

## APPENDIX F

## TABLE XVI

### SUMMARY TABLE OF ANALYSIS OF VARIANCE
### TOTAL POPULATION
### TOTAL SCORES (TS)

| Source | df | ss | ms | F |
|---|---|---|---|---|
| Between Subjects | 99 | 6160.74 | 62.22 | |
| AB(b) | 4 | 99.97 | 24.99 | |
| AC(b) | 4 | 58.73 | 14.68 | |
| BC(b) | 4 | 206.43 | 51.61 | |
| ABC(b) | 12 | 867.66 | 72.31 | |
| error(b) | 75 | 4927.95 | 65.70 | |
| Within Subjects | 400 | 2967.60 | 7.42 | |
| A | 4 | 12.93 | 3.23 | .51 |
| B | 4 | 220.49 | 55.12 | 8.81*** |
| C | 4 | 131.25 | 32.81 | 5.25*** |
| AB(w) | 12 | 79.90 | 6.66 | 1.07 |
| AC(w) | 12 | 180.78 | 15.07 | 2.41** |
| BC(w) | 12 | 161.22 | 13.44 | 2.15* |
| ABC(w) | 52 | 305.23 | 5.87 | .94 |
| error(w) | 300 | 1875.80 | 6.25 | |
| Total | 499 | 9128.34 | | |

A—Reinforcement Contingency
B—Order of Administration
C—Criterion Differences

* Significant at .05 level
** Significant at .01 level
*** Significant at .001 level

# APPENDIX G

## TABLE XVII

## SUMMARY TABLE OF ANALYSIS OF VARIANCE TOTAL POPULATION (NR) SCORES

| Source | df | ss | ms | F |
|---|---|---|---|---|
| Between Subjects | 99 | 7057.30 | 71.29 | |
| AB(b) | 4 | 239.69 | 59.92 | |
| AC(b) | 4 | 85.97 | 21.49 | |
| BC(b) | 4 | 352.99 | 88.25 | |
| ABC(b) | 12 | 892.60 | 74.38 | |
| error(b) | 75 | 5486.05 | 73.15 | |
| Within Subjects | 400 | 3367.60 | 8.42 | |
| A | 4 | 13.77 | 3.44 | .46 |
| B | 4 | 187.13 | 46.78 | 6.30*** |
| C | 4 | 262.75 | 65.69 | 8.85*** |
| AB(w) | 12 | 35.06 | 2.92 | .39 |
| AC(w) | 12 | 288.16 | 24.01 | 3.24** |
| BC(w) | 12 | 206.98 | 17.25 | 2.32** |
| ABC(w) | 52 | 147.55 | 2.84 | .38 |
| error(w) | 300 | 2226.20 | 7.42 | |
| Total | 499 | 10424.90 | | |

A—Reinforcement Contingency
B—Order of Administration
C—Criterion Differences

* Significant at .05 level
** Significant at .01 level
*** Significant at .001 level

# APPENDIX H

## TABLE XVIII

## SIMPLE EFFECTS OF ORDER OF ADMINISTRATION AND CRITERION DIFFERENCES ON EACH TYPE OF REINFORCEMENT SEPARATELY, SUMMARY TABLE

| Source | df | ss | ms | F |
|---|---|---|---|---|
| R1 | | | | |
| B | 4 | 33.70 | 8.43 | .41 |
| C | 4 | 82.70 | 20.68 | 1.01 |
| cells | | (419.50) | | |
| BC | 16 | 303.10 | 18.94 | .93 |
| within | 75 | 1530.25 | 20.40 | |
| Total | 99 | 1949.75 | | |
| R2 | | | | |
| B | 4 | 82.10 | 20.53 | 1.34 |
| C | 4 | 40.50 | 10.13 | .66 |
| cells | | (444.50) | | |
| BC | 16 | 321.90 | 20.12 | 1.32 |
| within | 75 | 1146.25 | 15.28 | |
| Total | 99 | 1590.75 | | |
| R3 | | | | |
| B | 4 | 70.00 | 17.50 | 1.14 |
| C | 4 | 42.20 | 10.55 | .69 |
| cells | | (378.50) | | |
| BC | 16 | 266.30 | 16.64 | 1.09 |
| within | 75 | 1147.50 | 15.30 | |
| Total | 99 | 1526.00 | | |
| R4 | | | | |
| B | 4 | 128.30 | 32.08 | 1.57 |
| C | 4 | 77.60 | 19.40 | .95 |
| cells | | (697.50) | | |
| BC | 16 | 491.60 | 30.73 | 1.65 |
| within | 75 | 1539.25 | 20.52 | |
| Total | 99 | 2236.75 | | |
| R5 | | | | |
| B | 4 | 86.26 | 21.57 | 1.16 |
| C | 4 | 127.76 | 31.94 | 1.71 |
| cells | | (371.66) | | |
| BC | 16 | 157.64 | 9.85 | .53 |
| within | 75 | 1395.50 | 18.61 | |
| Total | 99 | 1767.16 | | |

B--Order of Administration
C--Criterion Differences

## APPENDIX I

### TABLE XIX

### SIMPLE EFFECTS OF REINFORCEMENT AND ORDER OF ADMINISTRATION ON EACH CRITERION TASK SEPARATELY, SUMMARY TABLE

| Source | df | ss | ms | F |
|---|---|---|---|---|
| Task A | | | | |
| A | 4 | 63.86 | 15.97 | .87 |
| B | 4 | 107.86 | 26.97 | 1.47 |
| cells | | (421.46) | | |
| AB | 16 | 249.74 | 15.61 | .85 |
| within | 75 | 1375.50 | 18.34 | |
| Total | 99 | 1796.96 | | |
| Task B | | | | |
| A | 4 | 52.70 | 13.18 | .85 |
| B | 4 | 59.80 | 14.95 | .96 |
| cells | | (418.00) | | |
| AB | 16 | 305.50 | 19.09 | 1.23 |
| within | 75 | 1164.75 | 15.53 | |
| Total | 99 | 1582.75 | | |
| Task C | | | | |
| A | 4 | 45.34 | 11.34 | .64 |
| B | 4 | 171.74 | 42.93 | 2.44 |
| cells | | (469.14) | | |
| AB | 16 | 252.06 | 15.75 | .90 |
| within | 75 | 1317.25 | 17.56 | |
| Total | 99 | 1786.39 | | |
| Task D | | | | |
| A | 4 | 38.54 | 9.64 | .83 |
| B | 4 | 21.04 | 5.26 | .21 |
| cells | | (344.74) | | |
| AB | 16 | 285.16 | 17.82 | 1.40 |
| within | 75 | 1862.25 | 24.83 | |
| Total | 99 | 2206.99 | | |
| Task E | | | | |
| A | 4 | 52.00 | 13.00 | .83 |
| B | 4 | 136.70 | 34.18 | 2.18 |
| cells | | (540.00) | | |
| AB | 16 | 351.30 | 21.96 | 1.40 |
| within | 75 | 1177.00 | 15.68 | |
| Total | 99 | 1717.00 | | |

A—Reinforcement Contingency
B—Order of Administration

## APPENDIX J

### TABLE XX

### SIMPLE EFFECTS OF REINFORCEMENT AND CRITERION DIFFERENCES ON EACH TRIAL SEPARATELY, SUMMARY TABLE

| Source | df | ss | ms | F |
|---|---|---|---|---|
| Trial 1 | | | | |
| A | 4 | 38.56 | 9.64 | .87 |
| C | 4 | 15.36 | 3.84 | .35 |
| cells | | (864.14) | | |
| AC | 16 | 810.69 | 50.67 | 4.57* |
| within | 75 | 831.50 | 11.09 | |
| Total | 99 | 1696.11 | | |
| Trial 2 | | | | |
| A | 4 | 24.24 | 6.06 | .32 |
| C | 4 | 59.84 | 14.96 | .80 |
| cells | | (309.74) | | |
| AC | 16 | 225.66 | 14.10 | .75 |
| within | 75 | 1403.25 | 18.71 | |
| Total | 99 | 1712.99 | | |
| Trial 3 | | | | |
| A | 4 | 76.54 | 19.14 | 1.06 |
| C | 4 | 41.54 | 10.39 | .57 |
| cells | | (310.34) | | |
| AC | 16 | 192.26 | 12.02 | .67 |
| within | 75 | 1360.25 | 18.14 | |
| Total | 99 | 1670.59 | | |
| Trial 4 | | | | |
| A | 4 | 25.00 | 6.25 | .32 |
| C | 4 | 204.90 | 51.23 | 2.62* |
| cells | | (511.50) | | |
| AC | 16 | 281.60 | 17.60 | .90 |
| within | 75 | 1465.50 | 19.54 | |
| Total | 99 | 1977.00 | | |
| Trial 5 | | | | |
| A | 4 | 28.46 | 7.12 | .40 |
| C | 4 | 177.26 | 44.32 | 2.48 |
| cells | | (482.66) | | |
| AC | 16 | 276.94 | 17.32 | .97 |
| within | 75 | 1338.50 | 17.85 | |
| Total | 99 | 1821.16 | | |

A—Reinforcement Contingency
C—Criterion Differences

* Significant at .05 level

## APPENDIX K

### TABLE XXI

### SIMPLE EFFECTS OF REINFORCEMENT ON EACH TASK ON TRIAL NUMBER ONE ONLY, SUMMARY TABLE

| Source | df | ss | ms | F |
|---|---|---|---|---|
| Task A | | | | |
| A | 4 | 60.80 | 15.20 | 1.69 |
| within | 15 | 134.00 | 8.00 | |
| Total | 19 | 194.80 | | |
| Task B | | | | |
| A | 4 | 98.20 | 24.55 | 2.20 |
| within | 15 | 169.00 | 11.27 | |
| Total | 19 | 267.20 | | |
| Task C | | | | |
| A | 4 | 132.20 | 33.05 | 1.30 |
| within | 15 | 382.00 | 25.47 | |
| Total | 19 | 514.20 | | |
| Task D | | | | |
| A | 4 | 67.30 | 16.83 | .78 |
| within | 15 | 321.50 | 21.43 | |
| Total | 19 | 388.80 | | |
| Task E | | | | |
| A | 4 | 116.00 | 29.00 | 2.56 |
| within | 15 | 169.75 | 11.32 | |
| Total | 19 | 285.75 | | |

# APPENDIX L

## TABLE XXII

## EFFECTS OF REINFORCEMENT AT DIFFERENT LEVELS OF INTELLIGENCE, MENTAL AGE AND SOCIAL CLASS STATUS, SUMMARY TABLE

| Source | df | ss | ms | F |
|---|---|---|---|---|
| Low I.Q. | | | | |
| Reinforcement | 4 | 14.29 | 3.57 | .61 |
| Subjects | 24 | 1861.29 | 77.55 | |
| R x S | 96 | 565.51 | 5.89 | |
| Total | 124 | 2441.09 | | |
| High I.Q. | | | | |
| Reinforcement | 4 | 17.31 | 4.33 | .48 |
| Subjects | 24 | 1685.39 | 70.22 | |
| R x S | 96 | 867.09 | 9.03 | |
| Total | 124 | 2569.79 | | |
| Low M.A. | | | | |
| Reinforcement | 4 | 26.44 | 6.61 | 1.35 |
| Subjects | 24 | 906.21 | 37.76 | |
| R x S | 96 | 470.36 | 4.90 | |
| Total | 124 | 1402.01 | | |
| High M.A. | | | | |
| Reinforcement | 4 | 17.65 | 4.41 | .50 |
| Subjects | 24 | 1212.21 | 50.51 | |
| R x S | 96 | 854.95 | 8.91 | |
| Total | 124 | 2084.81 | | |
| Low Social Class | | | | |
| Reinforcement | 4 | 13.15 | 3.29 | .48 |
| Subjects | 24 | 1325.95 | 55.25 | |
| R x S | 96 | 660.05 | 6.88 | |
| Total | 124 | 1999.15 | | |
| High Social Class | | | | |
| Reinforcement | 4 | 30.40 | 7.60 | .99 |
| Subjects | 24 | 1814.00 | 75.58 | |
| R x S | 96 | 734.40 | 7.65 | |
| Total | 124 | 2578.80 | | |

## APPENDIX M

## TABLE XXIII

## EFFECTS OF REINFORCEMENT WITHIN EACH SEX, SUMMARY TABLE

| Source | df | ss | ms | F |
|---|---|---|---|---|
| Girls | | | | |
| Reinforcement | 4 | 42.70 | 10.68 | 1.73 |
| Subjects | 35 | 1537.98 | 43.94 | |
| R x S | 140 | 863.30 | 6.17 | |
| Total | 179 | 2443.98 | | |
| Boys | | | | |
| Reinforcement | 4 | 15.73 | 3.93 | .48 |
| Subjects | 63 | 4622.76 | 73.38 | |
| R x S | 252 | 2045.87 | 8.11 | |
| Total | 319 | 6684.36 | | |

Typed by

Elizabeth Crosley

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